Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA.

VOL. XXXVI. No. 12. NEW YORK, WEDNESDAY, MARCH 21, 1900. ISSUED WEEKLY.

Electrical Review

TIMES BUILDING, 41 PARK ROW,
P. O. BOX 2339. NEW YORK.

CHARLES W. PRICE, - - - - - EDITOR.
STEPHEN L. COLES, - - MANAGING EDITOR.
CHARLES T. CHILD, - - TECHNICAL EDITOR.
STEPHEN H. GODDARD, - - ADVERTISING MANAGER.
RUSSELL HOWLAND, ASS'T ADVERTISING MANAGER.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," - - - - NEW YORK.

TELEPHONE CALL, 1546 "CORTLANDT."

WESTERN OFFICE:
FRANK E. COLBERT, - REPRESENTATIVE,
955 Old Colony Building, Chicago.

WASHINGTON OFFICE:
GEO. C. MAYNARD, - - REPRESENTATIVE,
Room 102. Washington Loan and Trust Building,
WASHINGTON, D. C.

LONDON OFFICE:
HENRY W. HALL, - REPRESENTATIVE,
42 Old Broad Street, LONDON, E. C.
News, Subscriptions and Advertisements.

Subscription to the ELECTRICAL REVIEW.

One Year, United States and Canada, - - $3.00
One Year, Foreign Countries, - - - - - 5.00
Single Copies, each - - - - - - - - .10
Copies can be supplied for only one year back, at 25 cents each.

CONTENTS: PAGE

The Need for Cable-Ships..... 281
X-Rays..... 282
The Third Rail..... 282
An Export Opportunity..... 282
Copper..... 282
The Chicago South-Side Elevated Railway Plant..... 283
A Plea for the Education of the Hand..... 284
The Plymouth Corporation Electric Works, Plymouth, England..... 286
Our Canadian Letter..... 288
A Motor-Driven Surgical Saw..... 289
Literature..... 289
On the Theory and Practice of Getting Jobs..... 290
Science Brevities..... 291
Copper..... 292
Views, News and Interviews..... 293
The Electricity Building at the Pan-American Exposition, Buffalo, N. Y..... 293
British Appreciation of American Electric Fan Manufacturers..... 294
Suit Against Telephone Manufacturers..... 294
American Water-Wheel Governors in Argentina..... 294
Automatic High-Speed Engines for Driving Dynamos. 294
Electric Lighting..... 295
An Electrical Feature of the Military Tournament... 296
American Bell Stockholders' Meeting..... 296
Metropolitan Buys Third Avenue..... 296
The Franklin Institute..... 296
Obituary..... 296
New York Electrical Society..... 296
Wall Street and the Electrical Stock Market..... 296
Independent Telephone Rumor..... 296
Chicago Electrical Association..... 296
A Relay for Railway Switch Signals..... 297
Telephone and Telegraph..... 297
Notes on Electric Traction Under Steam Railway Conditions..... 298
Novel Designs in Electric Light Fittings..... 301
Export Notes..... 302
Industrial Notes..... 303
Free Evening Schools of the General Society of Mechanics and Tradesmen..... 303
Electric Railways..... 303
Advance Information..... 304
The American Bell Telephone Company..... 304
Receiver Appointed..... 304
Electrical Patents..... 27

Advertisers' Index, page 12.

THE NEED FOR CABLE-SHIPS.

In the discussion concerning the building of a trans-Pacific cable, a number of very interesting facts should be considered. The process of manufacturing deep-sea cable of great length is one that is not generally understood. Almost equally important is the proper laying of the cable after it is made. In Europe the universal custom at present is for cables to be manufactured at points on deep water, the factories being adjacent to piers alongside of which the cable-ships lay, so that the cable is coiled up in the tanks on these vessels as rapidly as it is manufactured. In this way the unit of cable length is a shipful.

To undertake successfully the building of the trans-Pacific cable in this country will, therefore, necessitate the erection at the waterside of a sufficient plant or plants for its manufacture and the acquisition of several cable-ships to lay the individual sections. Such a factory with its machinery would cost about $1,000,000.

There are in the world about thirty-five cable-ships, of which more than twenty-five fly the British flag. Not one is American. The construction of the cable will, therefore, necessitate the building of at least two cable-ships, at a cost of about $600,000 each. Their operation and other costs of transporting and laying the cable will bring this figure for the ships up to about $2,000,000 before the cable is laid. The cable itself will cost in the neighborhood of $13,000,000, this price being based on a length of seven thousand nautical miles and a price of thirty cents per foot of the finished cable.

The greatest difficulty in the way is the question of cable-ships. It is useless to talk of chartering such vessels for the purpose of laying a seven thousand mile cable, for the reason that this cable will necessitate practically the continuous operation of one repair ship. The vessels must be large enough to handle the long lengths necessary and should be, of course, modern in all details. It is also no mere sentiment that dictates the necessity for these ships to be of American register. It is stated on good authority that in some of the recent British cruisers and other naval craft provision has been made for cable tanks and cable handling, so that these ships can be used for cable laying, repairing, cutting, etc., when not required for their military functions. It would seem that this fact contains a valuable suggestion for us, and that some of the new United States cruisers of moderate size might well be fitted to undertake the task of laying the Pacific cable. This is not entirely sufficient, however, for repair ships, as was stated above, can not be dispensed with.

The United States have a vast coast line and immense and growing maritime interests. They are the dominant power of the Pacific now, and their new territories in both Eastern and Western waters create an imperative demand for cable connections and facilities. They must have cable making and laying plants. In the case of the trans-Pacific cable the cost will be about $20,000,000. If it cost twice that much we should still need it sufficiently to build it. It must be built and that quickly. Consequently, in view of the facts stated above, if any department of the government is to undertake its construction, one of the first essentials is the cable-ships; provision for their construction or the alteration of other vessels to fit them for this duty should be made immediately.

Electrical people, as usual, have been prompt to take advantage of our new expansion policy. An electrical supply house established in Havana by an American, has been doing a successful business for six months past. A branch of an electrical firm in the far East has been doing business in Manila for several years.

X-RAYS.

Considerable light is being thrown upon the nature of X-Rays by recent investigations. It seems now hardly possible to doubt the close similarity of this form of radiation to ultraviolet light, and, indeed, it seems reasonable to assume that the X-ray is simple ultraviolet light of a wave length so short as to be comparable in size with molecular dimensions. This assumption of the nature of the radiation easily explains most of the observed phenomena, and probably will be found finally to explain all, since it is not conceivable that many different varieties of radiation can exist.

If it be admitted that we have some knowledge of the actual nature of the X-ray it seems fair that this name, which means simply the unknown quantity, should be given to the mysterious radiation that emanates from bismuth and other bodies without apparent source of energy. The extraordinary phenomena of this radiation that recently have been observed are apparently incompatible with the theory of the conservation of energy. To admit even for a moment the possible falsity of this foundation dogma of science is to invite a condition of chaotic bewilderment. Hence, the main efforts of physicists engaged in investigating this question at present are directed toward the discovery of the mysterious source of energy which supplies these emanations. So far there has been no indication of success in the search. What seem to be elemental bodies have been discovered, and their salts isolated, which possess a wonderfully high power of automatic radiation, but the cause of this extraordinary phenomenon is as deep a mystery as when its discovery startled the scientific world.

THE THIRD RAIL.

The installment of Mr. Boynton's paper presented in this issue of the ELECTRICAL REVIEW, contains some exceedingly interesting information about the behavior of what is commonly called the third rail. It appears that even with pressures as high as seven hundred volts the third rail laid between running tracks of an ordinary railway, gravel ballasted, needs practically no insulation at all. The leakage under these conditions is entirely insignificant, and thus one of the troubles which designers in earlier days thought was before them in attacking the problem of electric traction on large railways, is shown to have been non-existent. The difficulties with ice and sleet which Mr. Boynton mentions seem to be preventable, provided the conducting rail is lifted up on proper supports so that the collectors running along it may bear upon its lower or lateral face and not on top of it. It has already been suggested that the proper method of construction for such a rail would be to lift it on posts, not necessarily high ones, but high enough to permit the contact shoes to run on its under side, and then to put an inverted trough of some vitreous material over the top of the power rail so that accidental contact with it would be impossible for workmen and others engaged upon the tracks. This precaution appears unnecessary unless high voltages, relatively speaking, are used. For five hundred volts there appear to be no authentic cases of serious injury due to the action of the current. In this connection it is curious to note that every time a man falls off the structure of the Brooklyn, N. Y., Elevated Railway the newspapers at once declare that he has been killed by the deadly third rail.

There is no reason longer to doubt that it will be only a short time before most suburban lines doing large business will be equipped with some form of electric traction involving a conductor parallel with the tracks. This certainly will not take the form of a trolley wire for obvious reasons, and there is no more useful or interesting subject for discussion at this time than the details of such electrical equipment as will be necessary for these lines. Mr. Boynton's paper is an admirable example of the sort of discussion that is most needed.

AN EXPORT OPPORTUNITY.

The district in South Africa which is now the seat of war is likely to offer to American manufacturers a considerable field for the exploitation of machinery, and especially of electrical apparatus, when the present conflict is ended. With every war, particularly one of the uncompromising character of this one, there is great destruction of property This means the replacement of large amounts of machinery, especially of that adapted for mining work, and probably the general redesigning and overhauling of plants which will take this opportunity for modernizing their equipments. The region known as the Witwatersrand, in which is the city of Johannesburg, is one of the most productive of the gold-mining regions of the world. Much power is required for the operation of these mines and the extraction and working of the ores. There is no good fuel in the South African Republic, and consequently the cost of steam power is exceedingly high. The climate is dry and especially adapted to electrical power transmission lines, and the whole situation is such that upon the restoration of peace a large opportunity will offer itself for engineering works of a large and important character. This should not be overlooked by American manufacturers and exporters. With the development of the Transvaal under British rule after the present disturbances it is to be expected that that country will become more prosperous and absorb a considerable quantity of manufactured products.

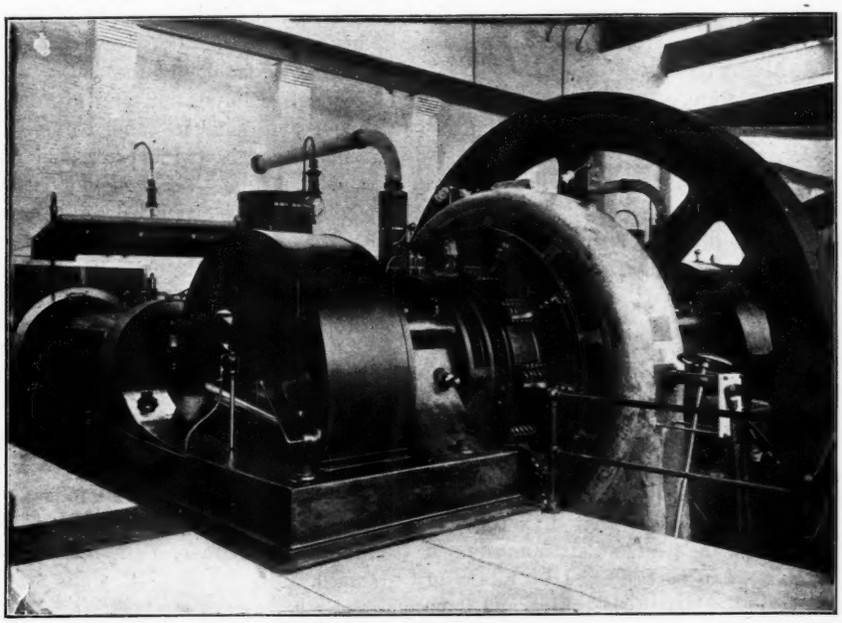
COPPER.

On another page of this issue of the ELECTRICAL REVIEW is an article on the copper situation, taken from a non-technical contemporary, but nevertheless an admirable and fair statement of the facts. It appears that there is no reason to suppose the price of copper will be reduced, for the demand for the metal is genuine and very large and more likely to increase than decrease. At the same time production is straining every effort to keep pace with consumption, but unsuccessfully. The rivalry of copper by aluminum as a conducting metal has not hitherto been seriously a factor in the situation, but it certainly will be if present indications hold true. The largest demand for conducting metals during the next few years will probably be for the equipment of electric railway lines, especially those of large size and high speed, which will come more directly in rivalry with existing steam railways. Upon this class of work the use of steel as a conducting metal is coming largely into favor. At any rate, the outlook is for high prices of copper for a long time, and the opportunity to urge the use of other metals in its place is distinctly at hand.

THE CHICAGO SOUTH-SIDE ELEVATED RAILWAY PLANT.

BY FRANK C. PERKINS.

The South-Side Elevated Railway, of Chicago, has a total length of track of 17 miles and has in operation over 150 cars. The president of the company is Mr. Leslie Carter, the secretary and treasurer is J. H. Glade and the location of offices is at 47 Congress street. Mr. M. Hopkins is general manager, and J. F. Morrison, superintendent. The accompanying illustration shows one of four of the engine-type direct-connected generators in the South-Side Elevated Railway power station. Each of the four units has a capacity of 800 kilowatts, generating a current of 1,455 amperes at a potential of 550 volts. They are of the 10-pole type and weigh 135,000 pounds each. The engines drive the dynamos at a speed of from 80 to 90 revolutions per minute. The total length of generator base is 204 inches and the total height is 166 inches.



A GENERATING UNIT IN THE PLANT OF THE CHICAGO SOUTH-SIDE ELEVATED RAILWAY.

A feature which is claimed to be of great importance in connection with this type of railway generators is that all the brushes of the same polarity are maintained at the same potential. Great difficulty has frequently been experienced in the operation of large multipolar direct-current machines with parallel-wound armature, it has been stated, owing to the difficulty of securing the same magnetic flux at all the poles. The potential generated in the conductors under one pole sometimes exceeded, or was less than, that generated in the conductors similarly situated under another pole of the same polarity, the result being a slight difference of potential between brushes of similar polarity, which cause currents, sometimes of considerable magnitude, to flow from one brush to another and from one section of the armature winding to another, attended by annoying and wasteful heating of the conductors and sparking of brushes. This difficulty is obviated in railway generators of this type by the following method of balancing employed by the manufacturers:

A number of points in the armature winding, which are normally of equal potential, are connected by leads through which currents may pass from one section to the others with which it is connected in parallel. These currents are alternating in character and lead or lag with reference to their respective electro-motive forces, and thus magnetize or demagnetize the field magnets so as automatically to produce the necessary balance between them. This method of balancing is said to be of great advantage in eliminating the sparking at the brushes and other wasteful heating, which occurs when an armature becomes decentralized, due to wear of the bearings, or from other causes. When, on account of the armature being out of centre, the air gap on one side is greater than that on the opposite side, the potential generated in the coils on the side having the smaller air gap is considerably higher than that generated in the coils under poles of the same polarity on the opposite side; consequently a current corresponding to this difference of potential flows from one section of the winding to another through the brushes and connecting leads.

This type of generator is of the same construction as those described in the ELECTRICAL REVIEW of February 7, 1900, pages 134-5, and illustrated, showing engines and generators in the Mount Vernon street station of the Union Traction Company, of Philadelphia. Those installed in Philadelphia are of much larger size, each being of 1,500 kilowatts capacity.

By the above described method of balancing the magnetic circuits, a great advantage in preventing any bearing magnetic pull on one side of the armature should it get out of centre by wear of the bearings is claimed. The pull which may be exerted by one side of the field on a large armature, even if out of centre by only a small fraction of an inch, may become as high as seven tons if no method of balancing is used. Such an increased pull on the armature would result in the heating and rapid wearing of the bearings. By proper balancing the induction under all poles is maintained practically the same, causing the magnetic pull to be equal at all poles and preventing an unbalanced pull. The invention of this method of automatically balancing the magnetic circuits of parallel-wound direct-current machines has but recently been made and should be of great value where large units are installed.

It is clearly noted that the armature could be considerably out of centre, when balanced properly, and still no injurious results occur, as the balancing currents do not flow through the brushes, but through the specially provided connections, as explained above. In addition to this, the fact that the currents in these conductors are alternating currents, which are "leading" in some coils and "lagging" in other coils, enables a very small current effectually to balance the circuits.

The storage battery equipment of the South-Side Elevated Railroad is used particularly for regulation, and consists of two batteries located near the ends of the line about six miles apart, the power station being about midway. Each battery as originally installed consisted of 248 elements of chloride accumulators, having a capacity of 700 horse-power when discharging at the one-hour rate. The elements were installed in lead-lined tanks of sufficient size to permit of the enlargement of the batteries by addition of plates to 1,400 horse-power at one-hour's discharge. Each battery is connected in multiple with the line and is practically automatic. When the potential of the line falls by reason of increase of load, the batteries discharge into the line, and when the potential of the line rises, due to lightening of load, the batteries receive current from the line. Two feeders run from the power house to each battery, and by cutting in or out, one or both of these feeders, at the power station, the amount of work to be done by the batteries can be accurately governed.

A PLEA FOR THE EDUCATION OF THE HAND.*

BY WILLIAM I. CRANE.

It is a melancholy but admitted fact that the world is full of useless people. Most of these are Micawbers, waiting for something to turn up.

The purpose of this paper is to show that the large number of persons who are seeking, not for a certain something to do, but for anything to do, are out of employment, because of their inability (due to want of training) to express themselves, not orally, but manually; that all persons are capable of being trained to express themselves orally and manually; that they may, among the vast undeveloped resources of this big world, find plenty to do—plenty that will not only be useful, but that is actually waiting to be done.

The usual idea of a manual training school is that it is an institution where the public pays for the apprenticeship of a young man or a young woman, a purely private matter paid for by public money. A brief explanation of the relation of manual training to mind expression will lead us to the correct idea of the term.

The human mind is capable of two things or acts—understanding and expressing—receiving ideas and giving ideas. An idea simply received into the mind or simply created there, and not expressed, is of no value to any one except the person receiving or thinking it. Those ideas only have been of value to the human race that have found lingual or manual expression. It is evident that, without expression, we should have no great literary works, no great works of architecture, sculpture, music, or painting. Thus Art had never been born, and we should live with men all around us as much alone as was Robinson Crusoe on his island.

The mind has six ways of understanding or of receiving impressions—through the five senses of seeing, hearing, tasting, smelling and feeling, and the sense of temperature. All we know, or think, or feel, must necessarily come through these channels. They are Creation's ways of placing us in contact with the material world around us. Without them we should be worse than blind, deaf and dumb. We should have no knowledge whatever, not only of the world around us, but of the fact that there is one.

Thus, we are wisely placed, by means of these so-called senses, in connection with the material world around us. They are the adjustments between mind and matter; the railways of supply, leading from the world into the union depot of the mind. Through them, we understand—we receive impressions.

But nature has not thus gifted us in the matter of expression. She has given us but two channels of expression—the tongue and the hand. Except of some emotions, such as of anger and of sorrow, that may be expressed by means of the countenance, we can put out or express what the senses bring by the tongue and the hand only. Unfortunately, civilization has undertrained the latter, and overtrained the former, as every day bears witness.

The forms of expression by these two channels are six in number, ranging in order from lowest to highest as follows:

1. Mechanic arts.
2. Sculpture.
3. Painting.
4. Architecture.
5. Music.
6. Language.

In these different forms of expression, the blacksmith expresses himself with his hammer and anvil; the carpenter, with his saw and other tools; the sculptor, with his mallet and chisel; the painter, with his brush and paints; the architect, with his draughting tools; the musician, with voice or instrument; and the speaker, writer, or singer, with voice or pen.

Now, it will be noticed that of the six forms of expression that I have mentioned only the fifth and sixth, music and language, can be expressed by means of the tongue, while all the others, and these two also in part, can be expressed with the hand; so that, it seems, manual training, or the training of expression by the hand, is of vastly more importance than that of the tongue. It will also be seen that a deaf and dumb man, who has been trained to the highest manual expression, would, despite his want of one of the two channels of expression, be to the world, a much more valuable man than another man, gifted with both channels of expression, but trained in lingual expression only. For the deaf and dumb man could express himself to the world in the forms that are most useful, while the lingually trained man could usefully express himself in two only of the six forms, and partially, only, in these; for he would be excluded from instrumental music, and from writing or printing language. The deaf and dumb man would be a creature of the highest possible civilization (living in a palace decorated with sculpture and painting), while the other would be only a vaporing creature, living in caves, and subsisting on what Nature furnished him.

Hand in hand should go the development of understanding and expression from birth onward; and this double training should not stop, as it does stop, at the first grade, at the age of six. Why do we then stop the development of expression by the hand except in writing and a little drawing? That is, stop almost all expression, and go to "walling up" a so-called trained mind away from its environment by allowing the hand to grow up "all thumbs," when the child with the "trained mind" must, by this very hand, work out, or not work out, the divine conceptions of his mind? I must confess that this is inconceivable to me.

Between the kindergarten and the end of his grade-school life, there should be no change of front, but the double work of correlative impression and expression should go on, hand in hand, a just proportion of thought and its expression orally and manually. That amount only of thought should be given that can be properly expressed by its proper mode of expression; for when the child is grown up, his worth to himself and to the world will be proportion to his expression, while the excess of unexpressed proper thought will be dead matter to clog his brain or class him as a dyspeptic.

If we would carry out our purpose of hand and mind expression training, we must not stop manual training between the end of the kindergarten work and the sixth or seventh grade, where it is usually resumed.

Nor must we put our manual training school in a building at one end of the city, and the mind training school in a building at the other end of the city. Nor must we simply put them in the same building, nor simply in the same room of the same building; but in the same class, in the same lesson, in the same moment; hand in hand must go mind training and manual training, or impression and its corresponding expression.

We must make the high school and the college places where we shall turn aside from general mind training and general expression training, and make them schools where we shall prepare our youth to understand and to express that aim of life that shall be their life-expression.

Above all, we must understand the full meaning of the term mind training and its correlative terms, lingual training and manual training.

And what shall be the results?

First, interest, interest—the same as we see in the kindergarten, where every

* Republished by permission from *The Philistine.*

moment is a joy to the children; where they are not only thinking, but doing; not only receiving impressions, but giving expression to these impressions.

In the matter of interest, life has three stages: The kindergarten stage, where we do both processes, and are interested; the school-proper stage, where we are only impressed (sometimes), and where we are not interested; and the stage of active life, where we again begin to express, and where we are again interested. The failures in life are those who never get out of the second stage into the third.

Second, the next result will be the discovery of our life adaptability. By constant expression, lingually and manually, we discover our adaptability by the time we are fourteen, and thus are able to fit into our proper cog in the social machine. As it is at present, we fail to find our expressional adaptability until we have made a mistake in life by a wrong choice; and then it was too late to find the right line of life and fit ourselves for it. Many young men who graduate at the head of their classes in college, where, too often, mind-power only is trained, and who fail in putting out their mind-power into its proper expression among the people, are of this class. The writer knows a young man who graduated at the head of a class of about 60 in a great Ohio medical college, and who, in two or three years, quit practicing simply because he could not put out or express his mind-training to his people. This thought so preyed upon his mind that he became insane. Had this young man been properly trained manually, according to the meaning of the word as given in this paper, he would now occupy a place suited to his fine mental power. But he discovered his want of proper training too late. He had a "walled-up mind;" and the world is full of the same kind of walled-up minds.

Third, the feeling of strong mental power, but of expressional helplessness that oppresses our young men who leave school, and start out into active life, would vanish, and a sense of usefulness would take its place. It is not, to-day, so much a want of place as a want of specific usefulness that keeps so many young men out of "jobs."

Fourth, the great question of "life-tendency" would be solved; for we get a bad tendency of life only when we are not interested in what is good. And how can we be interested in what is good when our schools permit us only to think what is good, and not to do what is good?

Thus, it seems, we have somewhat overrated lingual training, and underrated manual training, doubtless because we have been accustomed to circumscribe the meaning of the word "manual training." And so it seems that we should reconstruct our idea of manual training, and give it a proper place in our school curricula; for it must be evident that the great majority of our ideas find expression manually, and not lingually, the tongue being able to give expression to those ideas that are immaterial only, while the hand may give expression to these, and must give expression to all the other forms of thought, for, of course, the hand and not the tongue must express our thoughts in matter, and in those things that exist after we are gone.

So there seems to be a necessity of manual training in all that the word implies, for thoughts and ideas are worthless to the world unless they are expressed in some way or other. Mute, inglorious Miltons may be a matter of poetic pity, but they are not pleasant to have around; we generally class them as dyspeptics.

I would define manual training as—the cultivation of the hand so that it may be able to express the ideas of the mind; to serve as an adjustment between mind and matter; to be the complement of the mind in man's struggle for the control of his environment.

Nearly all human effort has been wasted because it has not been directed by a clearly-defined, rational purpose. Purposeless effort attains a desired end by accident only; effort directed by a well-defined purpose goes straight to the desired goal. Want of purpose is the most prevalent and dangerous of human faults. Its presence shows advanced civilization; its absence shows a want of civilization. Purposeless effort is like shutting one's eyes when about to shoot. One is as likely to hit the target in one case as in the other.

Now manual training in the narrow acceptance of the term, has had a wrong purpose—the purpose of a school of apprenticeship. It is this purpose that needs reformation—a reformation in accordance with the broader and truer meaning of the term. The purpose of manual training should be to train the hand to express the mind, not in one trade or line of work, but to express whatever the mind of the person trained is capable of thinking or conceiving; in short, to be the complement of the mind.

With this purpose in view, it becomes necessary to reconstruct, to some extent, our general ideas of school work. It will be seen that we have been training the mind and the tongue, and not the mind, tongue and hand. The extent to which we have trained the hand has stopped at writing, or the expression, by signs, of language, and some little expression of material forms by drawing. In fact, we have been training "walled-up" minds, and then locking up the ideas we have evolved by neglecting to train the only organ by which they can ever get out to the world. I think that much of the unrest of people comes from the feeling of general uselessness—a feeling that "I am not doing any good for myself or for the world." We feel within us a something struggling for expression, and we can not "put ourselves out" in forms of matter representing the thoughts that are in the brain.

The kindergarten is the most perfect "all-'round" training school in the world. It trains, by wisely guided practice, the five senses in the receiving of correct impressions; and the ideas and forms thus taken in are at once expressed by both tongue and hand. Go into a good kindergarten, and see the "things of beauty" made by infants there; creations of paper as expressions of impressions of form and color and beauty entirely impossible to our manly and womanly "all-thumb" fingers. The ideal kindergarten is an ideal school of complete impression and complete expression—an ideal school of civilization, beside which our grade schools and our high schools are Hottentot Universities.

A young man or woman will find in his or her work the same joy as does a child in the kindergarten, if treated in the same rational way as is the kindergarten child.

Fifth, such manual training will result in the almost complete cessation of crime; for it will replace evil tendency with good tendency—the tendency resulting from a feeling of active usefulness to one's self and to society.

Sixth, manual training as I have defined it, will result in the development of the understanding and expressing man.

Seventh, with this kind of manual training, how the world would blossom! What farms, what shops, what factories, what edifices, what music, what poetry, what men, what women, what happiness, should we have, if we were allowed in childhood to be rational doers!

What must we do to accomplish these noble ends?

First, we must get rid of the old idea of manual training, and replace it with the true and broader idea. The result will be a hearty cooperation of the gen-

eral public; for it is safe to say that the public, when it understands a good thing, always does that thing. The opposition to the kindergarten comes from those only who are unfamiliar with the purpose and workings of the kindergarten. We must begin with the children lower down.

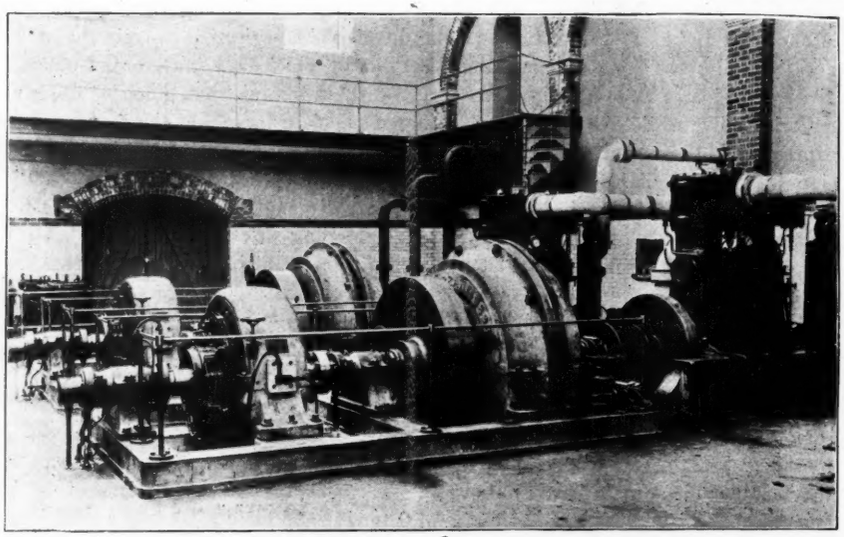


FIG. 1.—TWO GENERATING UNITS IN THE PLYMOUTH, ENGLAND, CORPORATION ELECTRIC WORKS.

That a child should begin his education at the age of six is simply a tradition resulting from long custom. We must allow no break in manual training between the close of the kindergarten work and the sixth or seventh year, as is now the custom.

We must "even up" thought and expression in the first, second, third, fourth, fifth and sixth grades, and the pupils will love school as do the kindergarten children their kindergarten. We must have more purpose in our work, and less "trust in God" shooting of ideas, as I may well call it.

We must stop "walling up" minds.

Lastly, if accidental, or at least individual, manual training has made the world what it is, what will purposeful and universal manual training do?

Our children will have new ideas of usefulness and of social relation.

We shall develop citizenship, and knowledge of the value of the state to the citizen, and of the value of the citizen to the state.

We know that all great men, as Homer, Milton, Napoleon, Angelo, Christopher Wren, Edison, and all the others, have been great men, not simply because they could think great thoughts, but because they could think and also express great thoughts.

Every man's value to society is exactly proportioned, not to his thinking power, but to his expressional power. Lingual and manual training of the kind I have described will bring every child to his highest power of expression, and thus to his true value to himself and to society.

And then we shall have efficient culture.

The Plymouth Corporation Electric Works, Plymouth, England.

The ceremony of opening the Plymouth Corporation Electric Works, at Prince Rock, and the inauguration of electric tramways took place September 22 last. Plymouth was the first town in England to be incorporated by act of Parliament, and was equally the first city to design an electrical plant combining both light and power. The business of the corporation has had so rapid a growth that within six months of commencing operation a contract has been placed which will double the supply of current.

The power plant is built on corporation land, at Prince Rock, on the Cattewater, the estuary of the River Plym. Three Lancashire boilers, rated at 350 horsepower each, furnish steam; they are operated at a pressure of 130 pounds, but are constructed for a working pressure of 160 pounds, to obviate reducing the working pressure as the boilers become old. Welsh coal is delivered by steamer to the wharf alongside the power house, and a branch of the London & South Western Railway runs in front of the works, which are thus supplied with ample accommodations both by land and water. Mechanical coking stokers are fitted to each boiler, and a complete system of coal-handling arrangements conveys the supply of fuel mechanically from the coal stores to the furnaces. An electric motor operates the mechanical stokers. An economizer of 256 tubes has been erected beside the boilers. A cast-iron tank, holding 28,000 gallons, upon the roof of the coal store, is fed by a three-inch pipe from the town mains, the supply of water being paid for at 2*d* (four cents) per thousand gallons. Alongside the power house there will shortly be constructed a refuse destructor for the town garbage. The electricity committee of the corporation will pay the works committee, who are responsible for the destructor, at the rate of one farthing (one-half cent) per kilowatt

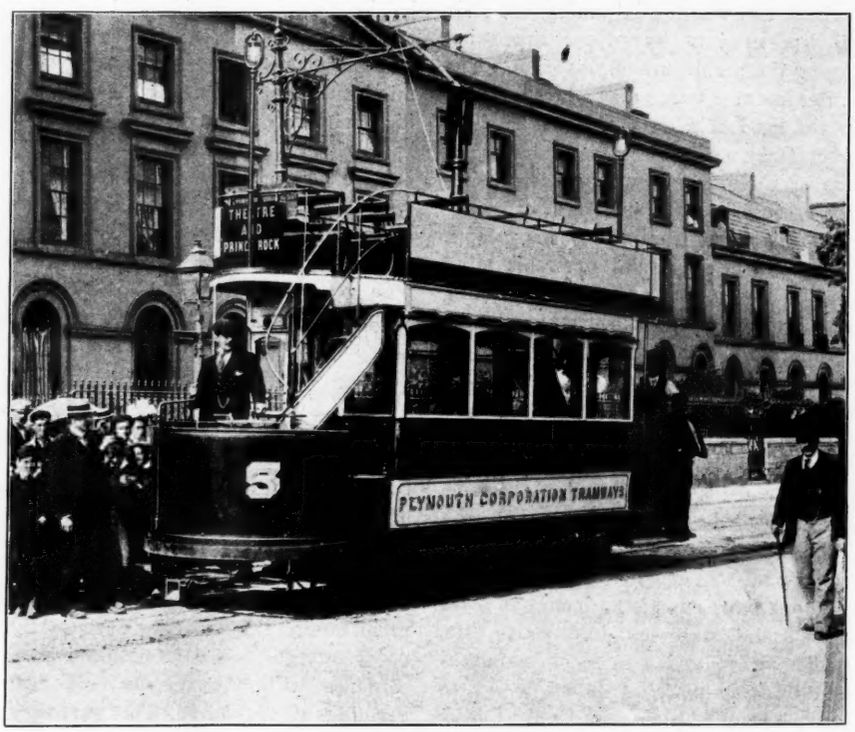


FIG. 2.—ONE OF THE DOUBLE-DECK ELECTRIC STREET CARS OF THE PLYMOUTH, ENGLAND, CORPORATION TRAMWAYS.

hour of electric energy produced. This arrangement will make a considerable saving in the cost of fuel for the electricity works, and will give over $7,500 a year to the credit of the destructor.

The generating machinery is contained in a building constructed principally of limestone, procured on the site, which has been excavated to a considerable depth below the original level. The spacious and lofty machinery room is designed to accommodate further units than those that are at present erected. The lighting and power plants are coupled together in a somewhat ingenious manner. The electrical equipment of the tramways was carried out by the Westinghouse Electric Company, Limited. Fig. 1 shows two sets of generators, each unit consisting of a high-speed compound engine of 150 horse-power and 275 revolutions per minute, direct coupled by means of a friction clutch to an alternator of 100 kilowatts and also to a direct-current generator of 100 kilowatts, both being on the same side of the steam engine. The engine is capable of driving either the alternator of the generator at full load, or both at half load, or each one in such proportion as the calls for alternating or direct current may require.

A storage battery of 260 Tudor cells is in parallel with the generator. During the day the engine can be run at full load, the alternator supplying whatever small amount of current is required for lighting, and the generator supplying direct current for the tramways. The storage battery, in parallel with the generator, provides for any heavy demand for the tramway service, any current beyond the needs of the tramway line being stored by the battery. By this means a practically constant load is kept upon the engines, and the cells of the battery are continually being charged, or are discharging, according to the demands of the circuit.

During the evening the demand for current for lighting purposes increases, and the supply of current for the tramway line is gradually taken off the generator and supplied by the battery, leaving the engine free to drive the alternator at full load for lighting. After midnight, when the lighting circuits are virtually closed and the cars have ceased running, the generator is driven at full load for charging the battery, until six o'clock in the morning, when the cars again commence to run.

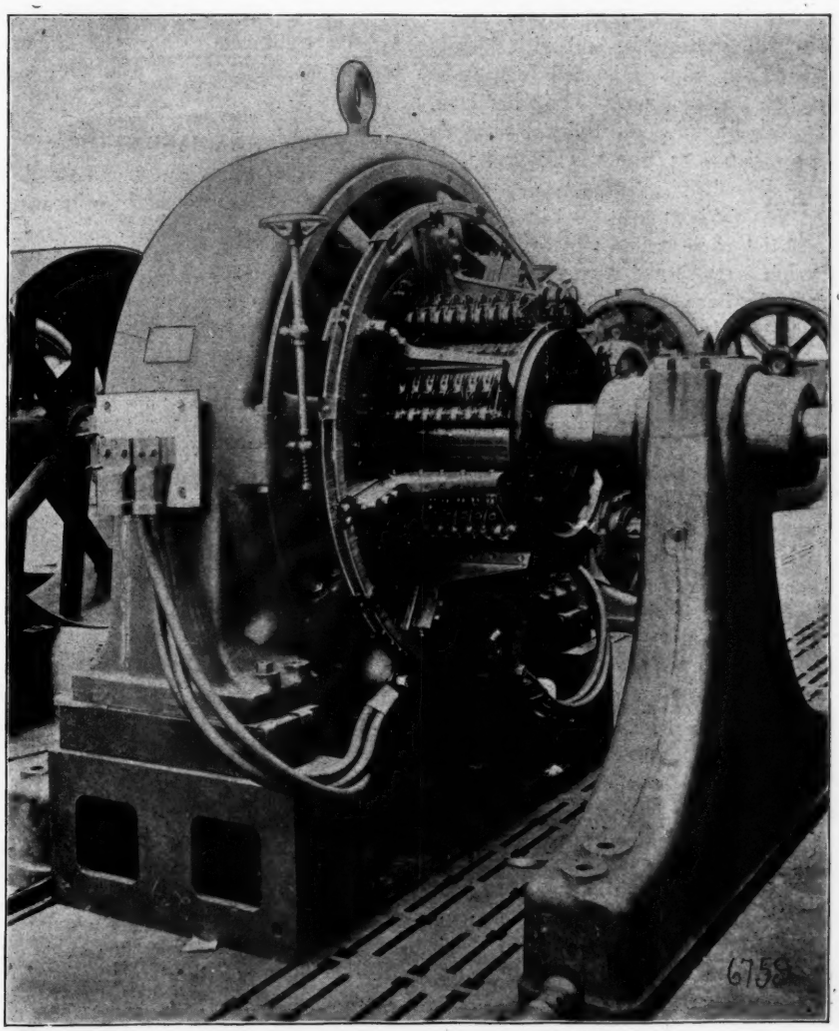


FIG. 3.—A 500-KILOWATT DIRECT-CURRENT GENERATOR FOR THE PLYMOUTH, ENGLAND, CORPORATION ELECTRIC WORKS.

The power house also contains two 200-kilowatt alternators, supplying current for lighting, driven at 250 revolutions per minute, and a 20-kilowatt booster, motor driven, used in series with the direct-current generator, so that the busbar pressure need not be raised. The booster generator is so arranged that when the demand for current is equal to the output of the generator, the battery will neither charge nor discharge. When the line current is less than the output, the booster will aid in the charging of the cells. When the line current is greater than the output, the booster will add a pressure to the battery circuit and thus help it to discharge.

Between each of the engines and the alternators and generators shown in the illustration, is a special shaft coupling, so that the engine can be disengaged when desired. The use of the clutch enables the generator and alternator to be used independently of the engine. On Sundays, when no cars run, the generator is operated as a motor from the storage battery, driving the alternator for whatever light-load there may be. Similarly the alternator can be run as a synchronous motor from either of the other alternators in the station, and the direct-current generator used either for charging the battery or for tramway work, with the battery in parallel. This plant was designed some two years ago, but if it were designed to-day, according to the latest practice in the United States, instead of separate alternators and generators, a combination alternating and direct-current generator would be employed.

The storage battery consists of 260 Tudor cells, of 600-ampere-hours capacity, the maximum discharge rate being 200 amperes. The Tudor Company maintains the battery under guarantee for 10 years at a rate of five per cent on the original cost. The contract stipulates that at any time within 12 hours of being fully charged, the battery must give its full specified capacity of 600-ampere-hours without the voltage per cell falling below 1.85 volts.

The power house is equipped with three switchboards for the lighting and power circuits, which are erected on a gallery upon two sides of the machinery room. The alternating-current switchboard is of the ordinary pattern, arranged on the single-pole principle. The direct-current tramway switchboard is of the usual design, and is fitted with the usual instruments for controlling and regulating the current. The regulating resistances are fixed in a room directly under the switchboard recess.

The length of the tramway lines already opened is three and one-tenth miles, running from the Theatre Royal to Prince Rock, but this is only a part of the projected line. Extensions are being made to Hyde Park, at Mutley, and from the Market Place to Compton, passing through the residential district of Mannamead, and later on, will be further extended to Pounds and Lipson. When these additional lines are completed the present type of combination generators will not be continued but there will be installed a steam-driven direct-current generator of 500 kilowatts, a battery for 1,700 ampere-hours at Compton, a 36-kilowatt booster and a 200-kilowatt motor-alternator.

Five different methods of carrying the overhead wires have been employed to suit the character of the road. Owing to the great number of telegraph and telephone wires, guard wires have been used for more than half the route, which rather detracts from the exceptionally artistic appearance of the overhead construction. The poles are three-sectional, with S. S. S. joints, of 7 inches, 6 inches and 5 inches outside diameter, with heavier poles of 8 inches, 7 inches and 6 inches diameter at curves. There are a few single-tube poles, 8 inches in diameter for half way and then tapering to 6 inches at the top. Arc lamps are fixed on the top of alternate poles in a number of the streets, and, where possible, on alternate sides of the street, a fiddle bow suspension between the ears holding the wires has been fitted to avoid oscillation of the lamps. The line is divided into one-half-mile sections, according to the British Board of Trade regulations, and insulated in the usual manner. Of the section boxes, two have been very neatly built into the walls of the corporation building. They contain four switch fuses, lightning arrester, telephone and wire terminals.

The motor cars have seating capacity for 20 inside and 22 outside. Each car is fitted with two Westinghouse No. 46 motors, giving 1,000 pounds tractive effort, at eight miles an hour. The controllers are of the series-parallel type, with graded brake. Perfect control is kept over the car by putting the two motors in parallel, and by connecting them by a variable resistance, if necessary, to the extent of short-circuiting the motors. This brake has been working very satisfactorily. The tracks are double nearly all the way. The rails are grooved girder section, 92-pounds, and 30 feet in length. The future extensions will probably be laid with 60-foot rails. Each joint is bonded with three No. 000 Chicago bonds, 30 inches long. The tests of the conductivity have given most satisfactory results. Probably no more difficult piece of tramway equipment has yet been completed in England, since the three miles already laid are through tortuous and narrow streets with extremely sharp curves.

The combination, supplying both light and power from the same units, enables the corporation to fix a low price for tractive purposes and for lighting circuits. In fact, Mr. Rider, the electrical engineer of the Plymouth corporation, in a speech made at the opening ceremony, stated that the prices charged were the lowest that had ever been offered at the opening of any electricity works. The tramway is charged three and one-half pence (seven cents) per unit (one kilowatt-hour) up to 150,000 units per annum; beyond this figure there will be a reduction in price. The contemplated extensions to tramway lines will necessitate some 600,000 units, the price for which it is estimated will be reduced to two and three-tenths pence (under five cents) per unit. The price for lighting for private customers is four and one-half pence (nine cents) per unit, and the same rate has been made for public lighting. The charge for an arc lamp, including cost of cleaning and maintenance, for one year is £16 ($78.00). According to Mr. Rider, the cost of electric lighting in Plymouth is about double that of gas, but the former gives about 20 times as much illumination as the latter, so that, in effect, the public, by using electricity, obtain 10 times as much value for their money. Twenty-one miles of mains have been laid on the three-wire system of distribution, and a large number of houses and stores are being connected up. At the date when the plant was started, connection had been made for 5,000 lamps, and applications in hand showed that this number would be increased to 8,000 before the end of the Winter.

The expectations of the resident engineer appear to have been more than realized, since the demand for current has already outrun the station capacity, and a contract has been placed with the British Westinghouse Electric and Manufacturing Company for a 500-kilowatt direct-current 550-volt engine-type generator, to be direct-coupled to a steam engine running at 330 revolutions per minute. A view of this generator is given in Fig. 3. Two boilers of 350 horse-power each will be added to the present equipment. For the Summer railway traffic 14 new cars are being built.

OUR CANADIAN LETTER.

OTTAWA, ONT.—The Dominion Government has voted $40,000 for an installation of electric light for the Lachine Canal.

CLINTON, ONT.—The Bell Telephone Company intend to construct a metallic line from this place to Kincardine *via* Wingham.

HALIFAX, N. S.—At a recent meeting of Council sites were considered for the proposed electric light plant, but no action taken.

OTTAWA, ONT.—After the present session of Parliament the Senate chamber and offices will be refitted and a new system of lighting installed.

PETERBOROUGH, ONT.—The Canadian General Electric Company purpose extending their works, and will likely erect a new building, 270 by 100 feet.

WOODVILLE, ONT.—The Victoria Telephone Company, at a recent meeting, decided to extend their line to Lindsay. J. G. Eyres, this place, is president of the company.

SHELBOURNE, ONT.—Negotiations are still in progress for the purchase of the existing light plant by Wright & McKinley, of Stratford, their intention being to add new apparatus.

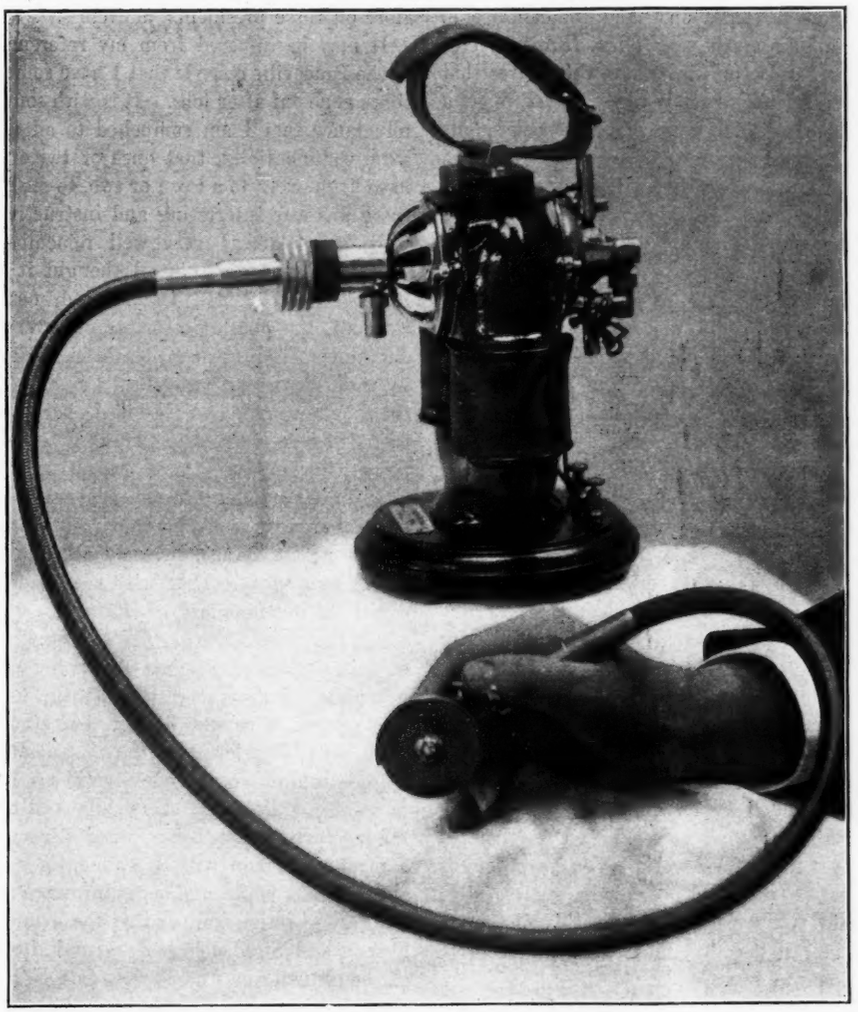
OTTAWA, ONT.—The two companies applying for charters to build an electric railway from Ottawa through the Winchester district to some point on the River St. Lawrence have amalgamated.

PETERBOROUGH, ONT.—A charter has been granted to the Central Ontario Power Company formed for the purpose of developing electrical energy at Burleigh Falls and constructing an electric railway in this vicinity. Among the incorporators are: Hon. Richard Harcourt, J. A. Calverwell and F. W. Barrett, of Toronto.

J. A. C.

Montreal, March 14.

A Motor-Driven Surgical Saw. – Electricity is rapidly finding a field of great usefulness in surgery, especially as a motive power for instruments required for the mechanical work of the surgeon. Such a machine is shown in the accompanying illustration, which represents a saw operated by an electric motor and designed to be used in those operations where hitherto a hand-saw has been employed for the cutting of bone or other hard matter.



A Motor-Driven Surgical Saw.

The motor is intended to consume about 100 watts from a 110-volt circuit and running at 2,200 revolutions per minute, develops in the neighborhood of one-tenth horse-power. It is arranged to be held in the hand of an assistant by means of the leather strap shown in the illustration, this construction enabling the assistant to follow the surgeon who is using the saw about as may be necessary for the purposes of the latter. The current is fed to the motor through a double push-button, such as is used with electrolier fixtures, so that holding it either in the same hand used to carry the motor or in the other, the assistant can instantly start or stop the saw as required. Attached to the motor shaft is a flexible spiral coil incased in a braided sheath, the whole being three feet long. This enables the utmost freedom of movement on the part of the operator, who holds the saw in his right hand as shown. The saw is not directly connected with the end of the shaft, but is attached to it through a right-angle bevel, so that it operates in a plane parallel with the end of the shaft. This is for greater convenience in handling the saw as it puts it in a better position for use.

This machine has already found an extensive use in several of the larger hospitals in New York city and has proved of value in severe operations where the shock attending the use of the slower-acting hand-saw has frequently proved fatal to the patient. In the difficult operation of craniotomy it has found especial use and has made a good record in both this and resection operations. The whole apparatus weighs about 12 pounds and is thus easily carried by the assistant, who stands near the operator. It is manufactured from an improved design by Mr. E. W. Caldwell, by the W. F. Ford Electric Instrument Company, 315 Fifth avenue, New York city.

LITERATURE

The Electrical Review has received from Secretary George F. Porter, the bound volume covering the proceedings of the twenty-second convention of the National Electric Light Association, held in New York city on May 23, 24 and 25, 1899. The volume is embellished by a frontispiece showing an excellent engraving of President A. M. Young. This volume of proceedings is notable for typographical excellence, which is not surprising when it is known that it is from the press of the James Kempster Printing Company, New York city.

"Of the making of books there is no end." This aphorism seems equally true in the making of technical journals. A new one, known as *La Pequeña Industria*, which, being literally interpreted, means the young industry, has just been started at Valencia, Spain, to popularize electricity in those parts. The journal is well printed on good paper and contains several departments of interest, among them one which does the Electrical Review the compliment of being closely modeled upon its well-known "News, Views and Interviews." It is with pleasure that we welcome our Spanish contemporary into the field and wish it all success.

The *Journal* of the Association of Engineering Societies, for January, contains a valuable and interesting article on the "Rapid Handling of Coal, Ore and Other Crude Commodities on the Great American Lakes," by Mr. Johnston. This work has been carried to higher perfection on the Great Lakes than anywhere else in the world, and the astonishing commerce of the lakes is well illustrated in Mr. Johnston's excellent paper. There are other papers of general technical interest in the journal, which is an excellent reflection of the prosperous condition of the Association of Engineering Societies. This association is not operated for profit, but for the general betterment of its membership.

"The Standard Guide to the City of Mexico and Vicinity" is a book to fill a want that the outpouring of English-speaking tourists into Mexico in recent years has made very pressing. Its compiler, Mr. Robert A. Barrett, has gathered, from the best sources, all the information regarding the picturesque old capital that travelers in Mexico require. Readers of the Standard Guide will know just what to see and when best to see it. The book contains more than 100 fine illustrations of Mexico City and, in addition to its practical value, forms an admirable souvenir for tourists to carry home from Aztec-land. It is published by the Modern Mexico Publishing Company, 120 North Fourth street, St. Louis.

ON THE THEORY AND PRACTICE OF GETTING JOBS.*

BY J. W. ALVORD.

In recently looking over a mass of pamphlets in one of our society libraries, I became impressed with the lack of attention to the very practical subject which I have chosen as the title of this paper. It is a cause for congratulation to note the completeness and care with which professional brethren have been willing to lay before use, in all possible detail, the methods that they have adopted, the researches that they have made, and the conclusions at which they have arrived after long and laborious study in the performance of jobs which they have already secured; but when it comes to the important and interesting problem, how to obtain such jobs, these writers are usually more than modest, and if, perchance, they hint at that phase of the subject at all, it is with the lightest and airiest touch, or the breathing of some such unsatisfying and elusive ritual as: "The committee having placed the matter in my charge," or "being consulted by the president of the company," or that still more common and unsatisfactory expression, "The writer being called in at this juncture to undertake the work," etc., etc.

I have enjoyed reading such phrases as these for many years. They appeal to my imagination. In my mind's eye I could see a committee of solid and influential citizens, after long and profound consultation, coming to my professional brother's office in a body and solemnly—one may almost say reverentially—"placing" the matter in his charge, unreservedly and fully, and with a simple and childlike confidence that in so doing they had fully insured the brilliant success of the proposed undertaking.

In the course of years of expectancy and yearning for jobs—and more of them—such delightful experiences as these have been somewhat few in my own career, and when the remotest similarity to the examples given have actually occurred, the experience has left me in a stunned condition of mind. In earlier years I naturally felt with humility that I was only clinging to the outskirts of the profession, hanging on to its extremities, as it were, and when I lost my first important salary and tried to get another, I felt a good deal like a cat does when it is thrown out of the upper window, and goes down with a rush, clawing, yowling and grabbing at everything in sight, in a vain attempt to ease the situation. My inability, at that time, to get my claws into anything tangible made a serious impression on me, which has only deepened with the lapse of time and the accumulation of experience.

At this particular point I desire to contrast the theory of getting jobs with the practice thereof. You open an office and you insert your business card in the technical papers. Then you brace yourself for the flood of business. Your professional rivals drop in one by one to ask "how it comes on," and incidentally to see how much your office furniture cost you, and otherwise assure themselves that you are not remotely likely, as yet, to get a job away from them. A few book agents vary the monotony of life, and once in a while a well-dressed life-insurance agent makes your heart jump into your mouth as you lead him into the inner office with every nerve braced to keep the joy cut of your face, as you try to assume a bored and indifferent air. I know of few more soul-wrenching moments than the one that comes when the life-insurance man discloses his business in that inner sanctum. It is for this, then, that those pumping engine details have been scattered over the table, and books on deep and abtruse subjects placed where they meet the eye! A man who can pass through these experiences without the freshness of his hope being perceptibly withered, has fitted himself for a better land.

But yet the theory seems to be all right. You are a professional man. Your work is such as to require confidence in you on the part of your clients. Consequently, it is indelicate on your part to push your claims to their notice. You feel competent to do their work. You have done it before, over and over again, successfully; but you must not intrude this fact upon their notice, but must wait for them to come to you.

These are the conclusions I have been led to, at any rate, after long years of perusal of engineering literature. I take delight in the theory. It accords with my own sensitive nature and my retiring disposition. I always read articles on the "Standing of the Engineer," and "Ethics of the Profession;" I am especially fond, too, of "Presidents' Annual Addresses." I consider them delightful reading. I well remember returning, seven years ago, from a $75 trip to Braceville (where I had been at my own expense, to see another engineer receive a job) being much comforted by reading the annual address of our worthy president. It seemed to relax the strain of the Braceville episode to read of the great achievements of the engineer along the different lines of his profession throughout the world, and to know once more that his was the opportunity to "harness the forces of nature to the uses of man." I have been familiar with that sentiment for many years, but it never seemed to have the same weight and swing as it did on this occasion. It calmed my nerves and filled me with a glow of hopefulness. I felt once more a man. I think we can not set too great a store on these presidents' addresses.

It may be inferred from my reference to the Braceville episode that I have sometimes gone out after jobs. It is with some reluctance that I am compelled to admit here, confidentially, that once or twice I have "run over" to a town or two, to see if there was any interesting and instructive work going on. I very well remember the first time I did this. I thought it a little singular that I should find, near the bait, the plain foot-prints of several distinguished professional brethren, versed in that particular specialty. Some of them, I was told, had "stopped over" on their way to important work at other points further on. Some had been invited by a particular friend, who was extremely anxious to see the important work in the proper hands. Nearly all fortunately happened to have with them some copies of testimonials of former work, which they would leave. The engineering of this particular job was finally let on proposals. I remember that at the letting several of us who happened to be in town were interviewed by the council one by one, behind closed doors—sized up, so to speak. I also remember while waiting for my turn to trot, being called aside by a mysterious man with a wandering eye and a sinister smile, and being informed in a highly secretive manner that the firm of Tripod and Sight-pole had secured three of the council and that there would be no show for me unless I would leave the matter with him—that he had a good deal of influence with the council and wanted to see me get that work. I remember being much touched by his sympathy and solicitude on my behalf, and saying to him earnestly that if awarded the work I would endeavor to do it well and faithfully, together with much more in the same strain, and net results of which, much to my surprise, seemed to cool his interest wonderfully. I noticed afterward that Messrs. Tripod and Sight-pole got the work, and I remember particularly being struck with the fact that there was a difference of 3,000 per cent between the

*Abstract of a paper read before the fourteenth annual meeting of the Illinois Society of Engineers and Surveyors.

highest and lowest bids. It is natural to abuse the wily councilman for his lack of appreciation of engineering ability, but it is hard to see how he can form a very high opinion of a profession whose members have such a variable estimate of themselves.

After my arrival home, I watched eagerly for next week's technical papers. Now, thought I, we will have this disgraceful competition exposed by an able editorial on "the folly of treating brains as merchandise," or "low depths of ignominy to which some town councils are sunk." I was disappointed. After searching vainly all through the news column, I found the following brief item in the next issue: "The services of Messrs. Tripod and Sight-pole, the well-known engineers of Metropolisville, have been secured by the city of," etc., etc.

After this, my confidence in the theory of getting jobs began to wane. I laid the theory on the shelf, as it were, and found myself compelled by urgent necessity to discover the practice. In the course of a number of years of heartrending experiences, I have, I think, discovered a few simple rules for getting jobs which, after much reluctance, I have concluded to give to the profession in absolute confidence. They have not always worked as well as I would like, but they at least give one a fair chance with other professional brothers, and they are as follows:

1. Find your job. This is quite necessary. I have completely discarded the theory on which I started in, that your job should find you. It may work once in a while, but as a rule a needy engineer out of work is a great deal keener hunter than a lonesome job is. After you have found jobs for a good many years, it is possible that some stray jobs may find you; but I wouldn't count on it.

2. Know a great deal more about how that job ought to be done than anybody else around. There is no doubt at all but that this is a very important requirement indeed in the practice of getting jobs, but it is one which I feel almost ashamed to mention, and indeed would have foreborne to speak of, had it not been that occasionally I have met enthusiastic and confident engineers eager and willing to lend a hand in the great work of harnessing the forces of nature, but a little uncertain as to the difference between the breeching and bellyband. This delightful trait of ambition in our profession should be commended, could it only be turned into proper channels.

3. Know the men who have the jobs to give. This last rule seems also to be one of those delightfully simple propositions, in theory, which are found so difficult in practice. The theory of the thing is that an engineer's reputation ought to precede him everywhere. In practice he is usually exceedingly glad if it will only follow him at a respectable distance.

People with jobs to give want to see you, poke your ribs, and put you through your paces, as I have elsewhere intimated. And if you would like to be their "hired man," it is best for you to go and submit yourself to the process as gracefully as you can. I believe, however, that it is quite possible to do all this and still be modest. There is no money in being bashful, but to be suitably modest, at the proper time and in the proper amount, is an art whose worth to the fortunate possessor can not be overestimated. Long years of harrowing experiences have frayed the edges and removed the bloom from my own early attempts to be modest. Yet I can not refrain from referring with pride to one attempt which may prove instructive. In the first year of my apprenticeship the city directory man called at the office in which I was engaged, and asked for my name and designation. Naturally, I did not feel at that time that I stood more than upon the threshold of our great and noble profession, so I informed him simply that I thought I might be entitled to be called an "engineer's assistant." I am at a loss to determine even to this day, whether this was an act of true modesty or mere bashfulness, but the classifier at the central office of that directory had evidently no difficulty whatever in placing me. He had met pretentious people before in his line of business, and when the directory was duly printed and issued, I was dumfounded to observe the appellation of "fireman" following my name and address.

It is pretty evident that the business world makes but little allowance for ordinary modesty, but it doubtless has distinct difficulty of its own in designating and classifying a profession which expects a man to drive stakes in a sewer, or paint landscapes in the office, or corner the elusive bacillus in the laboratory, or throw off a literary gem in the shape of a financial prospectus between meals.

Judge C. C. Clark has made an order in the United States Court, at Chattanooga, Tenn., confirming the sale of the property of the Morristown Telephone Company to the East Tennessee Company. This, it is supposed, will result in the East Tennessee Company securing all the franchises it wants in Morristown.

SCIENCE BREVITIES

Measuring the Velocity of X-Rays—M. B. Brunhes, in a recent note communicated to the French Academy of Sciences, describes a novel instrumental method for the measurement of the velocity of X-rays. The usual methods employed in measuring the velocity of light are not available for the X-rays for the reason that these are not reflected. The author, therefore, sought to use the reduction of the break-down strength of air produced by these rays as an indicator. Two micrometer spark gaps were set up at different distances from the tube and these were joined with a static machine which maintained the potential across them at such a point that it was just unable to spark under ordinary conditions. When the X-rays were produced and struck the spark gaps the sparks instantly appeared, naturally one after the other by reason of the greater distance of one of the gaps from the tube. The author used the method of Abraham and Lemoine in measuring the minute interval between the sparks and found that with the two micrometers only one metre apart this difference was perceptible. The preliminary measures have resulted in showing that the X-rays have a velocity of the same order of magnitude as that of the ultraviolet rays.

Luminescence of Immersed Electrodes—The well-known Italian investigator, Signor T. Tommasina, has described some curious phenomena in *Comptes Rendus*. He observed the luminescence of electrodes under the influence of the discharge of an induction coil. He filled some ordinary Crookes tubes with distilled water. The electrodes were aluminum disks attached to platinum wires. The disks became luminous, and so did the supporting wires when of aluminum instead of platinum. In many places minute gas bubbles traversed by sparks were observed, but the luminosity was not confined to those places. The disks could be photographed by their own light. The glow is essentially anodic, as evidenced by the fact that the current at break makes the anode luminous, and the current at make, the cathode. The luminosity, although apparently continuous at both electrodes, is really alternating. Only aluminum and, to a less extent, magnesium show this luminosity, and they only show it when immersed in water, alcohol or acidulated water, and not in dielectrics like petroleum or vaseline.

Copper.

[*From the New York Sun.*]

The signs multiply that the contest waged so long and bitterly between the English manufacturers of refined copper and the American producers thereof is closing. The struggle has not been dissimilar to that over raw cotton, already fully explained in the *Sun;* and the fact that two such battles have been precipitated has afforded no small corroboration of the opinion held by many competent observers that the successive failures in sagacity shown by English merchants and manufacturers raise the question whether or no the commercial prosperity of their country has passed its zenith. The British qualities of conservatism and obstinacy seem to have made it impossible for these merchants to adapt themselves to the conditions of modern competitive enterprise, and to have left them in the race behind the persistent and studious German and the inventive and energetic American.

As in the case of cotton, there was a scarcity of copper, due, however, not as in cotton, to reduced production, but to greatly enlarged consumption. English manufacturers declared that the rise in the value of copper, as in the case of cotton, was not due to normal and proper causes, but to speculation and to American manipulation and "corners." Now they have had to confess themselves mistaken and to accept the natural punishment of their error.

The rise in the copper market has progressed with various fluctuations ever since 1893. Up to that time for many years production had greatly outrun consumption, and a large quantity of the metal stored in reserve exercised a constantly depressing influence upon prices. At the period named the use of copper as the base of the modern industrial development of electrical heat and power began to dawn upon the mining and manufacturing world. The huge mass of reserve supplies of copper slowly diminished, while the price of the article as slowly but as steadily rose. All copper using interests were skeptical about the advance at first, but, in the course of two or three years, people who looked at the matter with their understanding, and not with their prejudices, became convinced of two great facts: First, that the new use of copper was not of an experimental and uncertain nature, but meant a vast permanent increase in the consumption of the article; and, secondly, that the sources of copper were, comparatively speaking, limited.

A great development of the copper-mining business began in the United States as soon as the new use of the metal became apparent, and in 1898 we were exporting considerably more than half of the raw copper used in the world, giving us control of the world's markets. The manufacturers of France and Germany gave up the fight after a brief struggle and began to buy enormously. But the English manufacturers wouldn't buy. In England, unlike the United States, raw copper is an article of speculation. The cash article and options for the future delivery of it are dealt in, in much the same manner that grain, cotton and similar commodities are in our own country. The English manufacturers still asserted that the rise in price was due to a gigantic American "corner," exactly similar to that which M. Secretan attempted to form in France some years ago, and they held that the same collapse would in a little while come on it. They therefore entered into extensive speculative operations for the decline in the price of option in copper. Moreover, they refused to buy the actual metal at the prevailing prices and allowed the business of manufacturing it to go to other lands, chiefly to our own country.

The charge that the rise in copper was due to a "corner" was, of course, preposterous, but the Englishmen entertained it with all stubbornness. It is hard for Americans to understand how such an idea could have lodged in business men's minds, when the figures showing the actual enormous increase in the world's consumption of copper were before them, and it was undisputed that in 1898 the exports of American copper were 300,000,000 pounds, almost four times those of the year before. The Englishmen declared that American copper concerns had bought enormously in the English market, taking copper back to America and then reshipping it to England again for the purpose of confusing the statistics of copper manufacture and imports! It is true that large American purchases of copper were made in the English markets, but this was chiefly because of the development of American business and the decay of English enterprise. It meant simply that so tremendous had been the advance in the improvements of copper refining and smelting in America that our refiners were able to buy the crude copper brought to England from Chili, bring it to the refineries of Perth Amboy and send it back to England at a large net profit on the transaction. There is little wonder that the far-famed refiners of Swansea were troubled at the progress of American metallurgists.

The English manufacturers asserted, finally, that the high prices commanded for copper would cause an increase in production which would defeat the ends of the imaginary American manipulators. It should be observed that these so-called high prices, while they have been rapidly attained, are still much below those which prevailed in years gone by. In 1888 the standard brand of copper sold at £105 per ton in the English market. The rise in price of the last six years has only resulted in an increase of about 10 per cent annually in the world's production and of this the greater proportion has been in our own country.

Bitter and determined, even if deluded, was the resistance made by the English buyers to the American producers of copper in the last half of 1898 and throughout 1899. Our exports of copper in 1899 were 30,000,000 pounds less than in 1898, yet at the close of the year our stocks of copper were less than at the same time the year previous, though our production had, in the meantime, greatly increased, showing that we, instead of the Englishmen, were doing the manufacturing. The price of copper, which in May of last year was £79 per ton in the English market, fell to £70 per ton in December. But that brought little help to England. The first weeks of January of 1900 found the English warehouses practically destitute of copper, and its manufacturers and speculators burdened by contracts for the decline, which they saw no hope of fulfilling. Meanwhile, the market for the article kept expanding. Owing to the stupendous demand for it by the shipbuilding plans of all the great nations, for telephone and trolley wires which are being strung around the world in constantly multiplying lines, it was evident that the use of copper in the coming Spring season and throughout the year would be upon a scale larger than ever known before. The English manufacturers and speculators gave up the battle. During the last two months they have been heavy and constant buyers of copper. The exports of American copper for January and February of the present year are nearly 25,000,000 pounds greater than for the same two months of 1899, so that the deficiency in the exports which 1899 showed over 1898 has been almost made good. Copper on Monday rose to £80 per ton in the London market, and, so far as any indication is apparent, it will rise higher before it greatly falls.

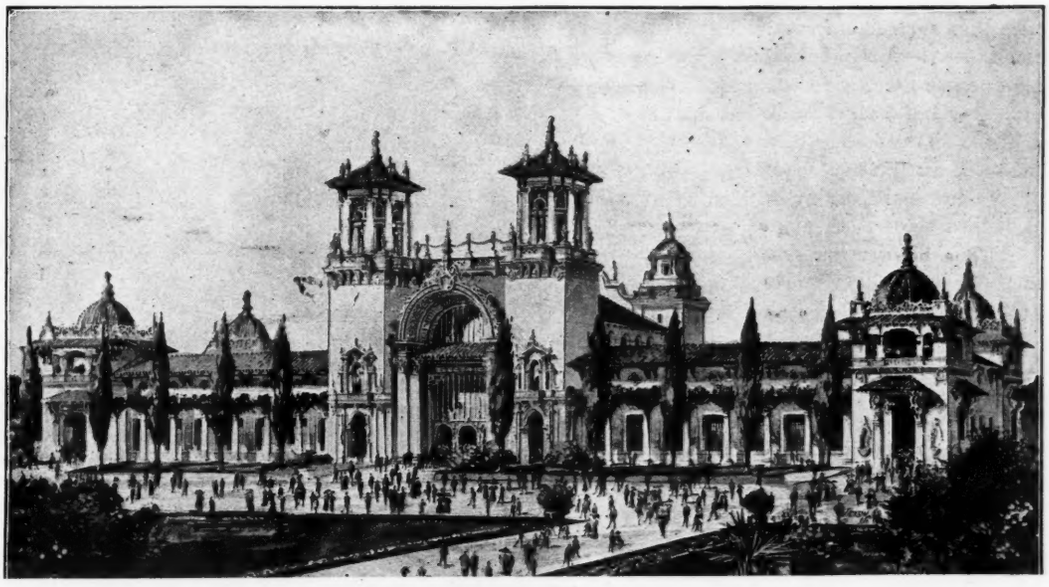
The metal aluminum was discovered by F. Wohler, in 1827.

VIEWS, NEWS AND INTERVIEWS

Under the will of the late Dr. John Stanford Sayre, U. S. N., retired, Princeton University will receive $40,000, part of which is for the endowment of fellowships in applied chemistry and in applied electricity.

"There is no place in the world where electric power transmission is so badly needed as West Australia," said an engineer, in conversation a few days ago. "There is no fuel to be had in the region except stumps. The timber was all burned up long ago and now we are using stumps which are dug up and sold by the pound, being too precious a material to dispose of by the cord. In addition to this difficulty, the water out there is about 10 per cent salter than the sea, so that a man has to burn stumps to distill the water and then burn more stumps to make steam of it. Goods coming out from England, especially those sent in sailing ships, are usually packed in standard size cases five by five feet and four feet high, lined with tin and made water-tight so that in case of shipwreck they may drift ashore uninjured. These cases come in handy as water tanks in West Australia, and after using one for about six weeks, I have found a layer of salt crystallized on the bottom of it six inches thick."

The phlegmatic Oom Paul Kruger has, despite his solemn appearance, a great reputation as a joker among his people in the Transvaal, says *Collier's Weekly*. His humor, however, tends toward the practical order. Here is an instance: Half a dozen back-country Boers had come to Pretoria to see the sights and, with characteristic familiarity, paid the President a visit during his early coffee-drinking hour. Later they were shown over the government buildings by the President in person. In one of the rooms an electric lamp was burning, and as they were passing out, Oom Paul, with his hand on the button, asked them to blow it out from where they stood. Then one after another drew a deep breath, blew out his cheeks, and sent out a tremendous puff, but all in vain; the light did not even wince. Then the President bade them look at him, and, puffing out his cheeks, gave a strong blast, at the same time slyly turning off the current. The visitors were amazed, and as they left the building, one who had been more observant than the rest remarked: "Oom Paul must have wonderfully strong lungs, for, did you notice, the light was entirely enclosed in glass."



THE ELECTRICITY BUILDING AT THE PAN-AMERICAN EXPOSITION, BUFFALO, N. Y.

The Electricity Building at the Pan-American Exposition, Buffalo, N. Y.

Elaborate designs have recently been completed for the Electricity Building for the Pan-American Exposition, to be held at Buffalo, N. Y., May 1 to October 31, 1901. Displays of all kinds in the practical and artistic uses of electricity, together with complete exhibits of electrical machinery and appliances are to be conspicuous features of the Exposition.

The designs contemplate a very handsome and commodious building. The structure is to be 500 feet from east to west and 150 feet wide, giving an exhibition space of 75,000 square feet.

The south facade fronts the Mall and the north fronts the Midway. The east end is toward the massive Electric Tower, while the west end faces the Grand Canal. The building is long, low and inviting. The design of the facades shows artistic grouping. The openings of the pergola-like loggias, placed at frequent intervals, present a delightful effect, showing more and more of the reveals of the pilasters and openings as the eye travels to the end of the building farthest away from the observer.

There is a pleasing ending at each corner of the building, with a low-domed pavilion tower, and the building is interrupted at the centre by the double-towered entrance. This entrance, wide and high, is spanned by an ornamental arch and supported each side by columns. The towers also have minor entrances through them.

The connecting work between the towers, the towers themselves, the pavilions at the corners of the buildings, and similar places, are to be brilliantly illuminated and made gay with banners and flags.

The modeled relief work of the building is of choicest design. The general ornamentation of the building is to be frescoes in an interesting mixture of reds, greens and yellows. The general color scheme follows that of the Machinery and Transportation Building and other groups of buildings of the Exposition. The building was designed by Green & Wicks, of Buffalo.

British Appreciation of American Electric Fan Manufacturers.

[*From the Electrical Engineer, London.*]

It is difficult to realize the tremendous extent to which small electric fans are used in America. Thus the ELECTRICAL REVIEW, of New York, published on Valentine's Day a description of the new types of fans for 1900. It seems very early in the year to think of providing against the dog days, but naturally the information given is of great value to agents who have to get their orders dispatched early. Ten pages of our contemporary's issue for the above mentioned date is devoted to different types and makes of electric fans, and a note at the end states that the description is to be continued in the next issue. We notice that our contemporary places the Lundell electric fans, as manufactured by the Sprague Electrical Company, first in the list, and that it states that the design of the fan blades has been considerably improved in the new types to enable larger quantities of air to be moved without increasing the consumption of power. Thus a 12-inch fan running at its normal speed now only requires some 52 watts at 115 volts. Other fans are described, the design of which seems to us to have been influenced by a desire to have novel shapes rather than anything else. Although the great majority of the illustrations have to do with small motors driving small fans, the type manufactured by the Sturtevant Engineering Company, designed for heavier work, are described and illustrated. These are made from 18 inches in diameter to 10 feet, and are capable of dealing with from 2,000 to 175,000 cubic feet of air per minute. With electric motors on the shaft of the fan very good cooling effects are obtained, so that the motors can be kept smaller than otherwise would be the case. We also notice in the new types certain small fans designed to work with primary batteries.

Suit Against Telephone Manufacturers.

The Rolfe Electric Company and the Eureka Electric Company, of Chicago, have brought suit against the Sterling Electric Company, of La Fayette, Ind. Frank B. Cook, W. E. Doolittle, Mortimer Levering and C. M. Murdock, are officers of that company.

The suit is brought to enjoin the Sterling Electric Company and its officers from manufacturing the Sterling protectors. The Rolfe and Eureka companies claim to own and control patents covering broadly protective devices for telephone and telegraph circuits, cables, cable-heads and the like, which patents they believe the Sterling protectors infringe.

The Rolfe and Eureka companies announce that they intend to push this suit against the Sterling Electric Company, and also to prosecute users of Sterling protectors for infringement of these patents.

American Water-Wheel Governors in Argentina.

In the ELECTRICAL REVIEW for March 7, 1900, was an article descriptive of the electrical features of the fine water-power driven plant of the Cordoba Light and Power Company, at Cordoba, in the Argentine Republic. An interesting feature of this plant, which was not described in the article mentioned, is the governing of the water-wheels. Two governors, made by the Lombard Water-Wheel Governor Company, of Boston, Mass., were shipped out with the rest of the hydraulic machinery and were set up by the engineers in charge of the work on the ground. They had never before seen one of the governors. The plant was a difficult one to govern, the head being high, the pen-stock long, and the kinetic energy of the moving water very great. To the credit of the engineers at the work, they got the governors into operation with great ease, and have operated them continuously since without trouble. As part of the load is very variable, this was by no means an easy thing to do, and it speaks well, not only for the engineers, but also for the governor.

Automatic High-Speed Engines for Driving Dynamos.

Much of the attention of mechanical engineers and those interested in electric lighting has been diverted to the large plants, where engines of great size, embodying many refinements, are installed. There is, however, as there has always been, a very large and constantly growing field for the small engine adapted to isolated plant lighting and other similar purposes.

The illustrations shown herewith represent a simple automatic engine which is built in small sizes up to fifty horse-power and is intended to prove an efficient and satisfactory machine in the ordinary operation of small plants. Figs. 1 and 2 show respectively the steam chest and cylinder side of the engine, while the governor in the flywheel is shown in Fig. 3. The design of the main frame or bed of the engine is such as to afford much strength and stiffness. The cylinder and steam chest overhang the end of the bed in the usual way, and are composed of one solid casting firmly bolted to the bed. The cross-head guides are part of the bed and have generous bearing surfaces. The cross-head is of an improved design, having the pin about mid-centre and is provided with gun-metal wedge-shaped shoes above and below for convenience of adjustment. This matter of fitting the cross-head pin easily enables it to be kept tight at all times. The piston rod is of steel and is turned down to a tight force fit

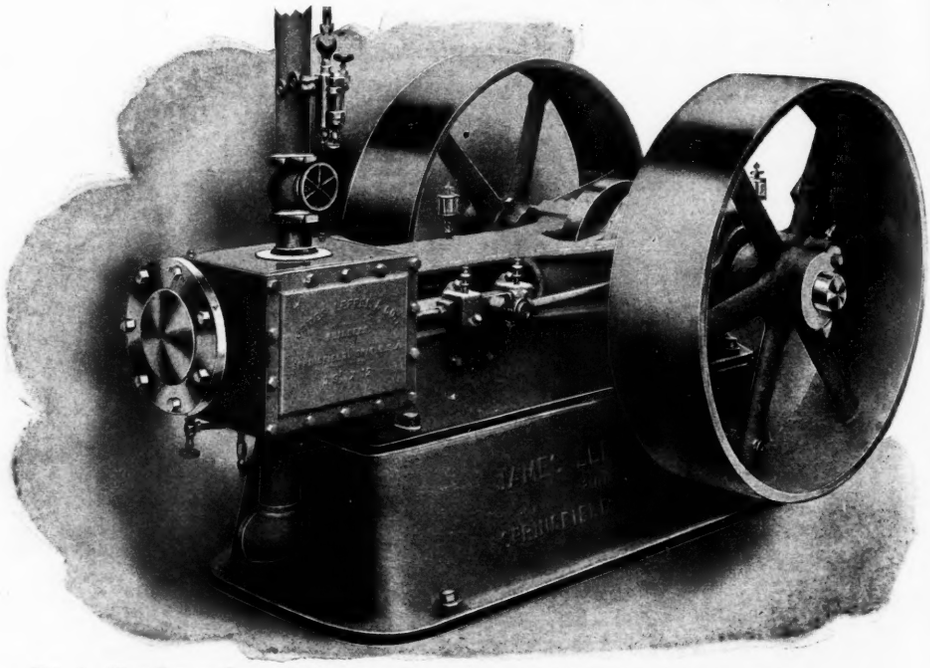


FIG. 1.—THE STEAM CHEST SIDE OF AN AUTOMATIC HIGH-SPEED ENGINE FOR DYNAMO DRIVING.

in the piston, a suitable shoulder being left outside. When this is forced home the end of the piston is securely riveted over on the back, firmly and tightly holding the rod in place. The main shaft is large and strong, being forged in one solid piece, and is provided with the usual counter-balance disks. A slide-valve of the skeleton rectangular form is used, it being

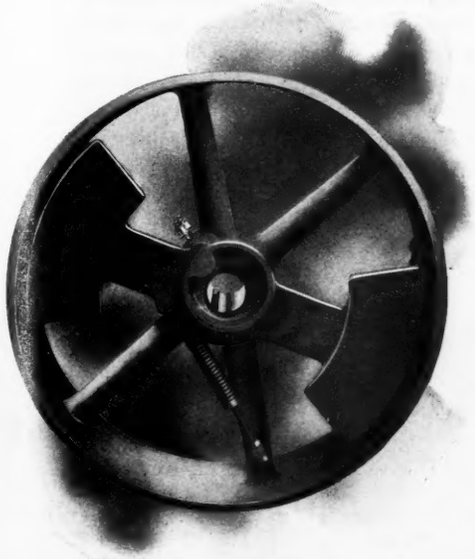


FIG. 3.—GOVERNOR FOR AUTOMATIC HIGH-SPEED ENGINE.

balanced by the adoption of a pressure-relieving plate on its back between the valve and steam chest lid. This valve is also arranged to afford the necessary relief in case of water accumulating in the cylinder. The claim of the makers for this valve is that it is so simple as to be easily understood and that it is not more troublesome to take care of than an ordinary slide-valve. The cylinders are drained by a simple device, not shown in the illustration, which is operated by one lever.

The governing system attached to the engines is of the well known Rites variety and is clearly illustrated in Fig. 3. The governor consists of one piece, comprising the arms and weights, with one spring connection, and is pivoted on one hard steel pin. The whole idea of the governor is to avoid any complexity of links and joints such as is sometimes met with.

These engines are built by James Leffel & Company, of Springfield, Ohio, who have long been known as makers of turbine water-wheels and other machinery.

H. B. Meech, a mineral expert from Boston, is at North Sydney, C. B., to select a site for large copper smelting works to be erected by a syndicate of American capitalists. It is estimated that the construction of the works will cost about $150,000, and the town council will be asked to make some concessions.

ELECTRIC LIGHTING

A proposition to install a municipal lighting plant will be submitted to the voters of Ishpeming, Mich., at the Spring election.

It is proposed to develop 4,700 horsepower from the falls at Anthony's Shoals for electrical transmission to Washington, Ga., for the operation of electric railways.

A dividend of three per cent on the capital stock of the Northport, L. I., Electric Light Company has been declared. The company is three years old and this is its first dividend.

The People's Electric Light and Power Company, of New Jersey, is absorbing all the thirteen smaller companies in Hudson and Essex Counties, and it will in turn combine with the United Electric Company.

It has developed that the control of the Queens Borough Electric Light and Power Company, of Brooklyn, N. Y., has passed to the Kings County Electric Light and Power Company, of which company Anthony N. Brady is president. This disposes of the report that the New York Gas and Electric Light, Heat and Power Company had bought the Queens Borough Company. That company has its plant at Far Rockaway and supplies with electric lights Lawrence, Cedarhurst, Rockaway Beach and other districts in Queens.

At a special meeting of the Common Council, of Yonkers, N. Y., the Committee on Lamps reported in favor of an act to be submitted to the Legislature authorizing the Common Council to establish a municipal electric light plant at a cost not to exceed $175,000.

The stockholders of the Consolidated Gas Company, of New York, at a special meeting, voted to increase the capital stock of the company from $39,078,000 to $54,595,200 by issuing 155,172 additional shares, of the par value of $100, for the acquisition of the $36,000,000 capital stock of the New York Gas and Electric Light, Heat and Power Company, in accordance with the resolution adopted by the Board of Trustees of the Consolidated on January 2. The new stock will be devoted to the retiring of the $36,000,000 debentures of the company issued by the trustees in exchange for the $36,000,000 stock of the Gas and Electric Company, these debentures having been made redeemable at the option of the Consolidated Gas Company, to be exercised within six months, in the capital stock of the latter company, at $232 a share. The New York Gas and Electric Light, Heat and Power Company, it may be said upon authority, is earning, over and above the sum required to meet all its fixed charges, fully 10 per cent on the $15,517,200 stock now issued by the Consolidated Gas Company in acquiring the $36,000,000 stock of the former corporation, and its business is growing rapidly.

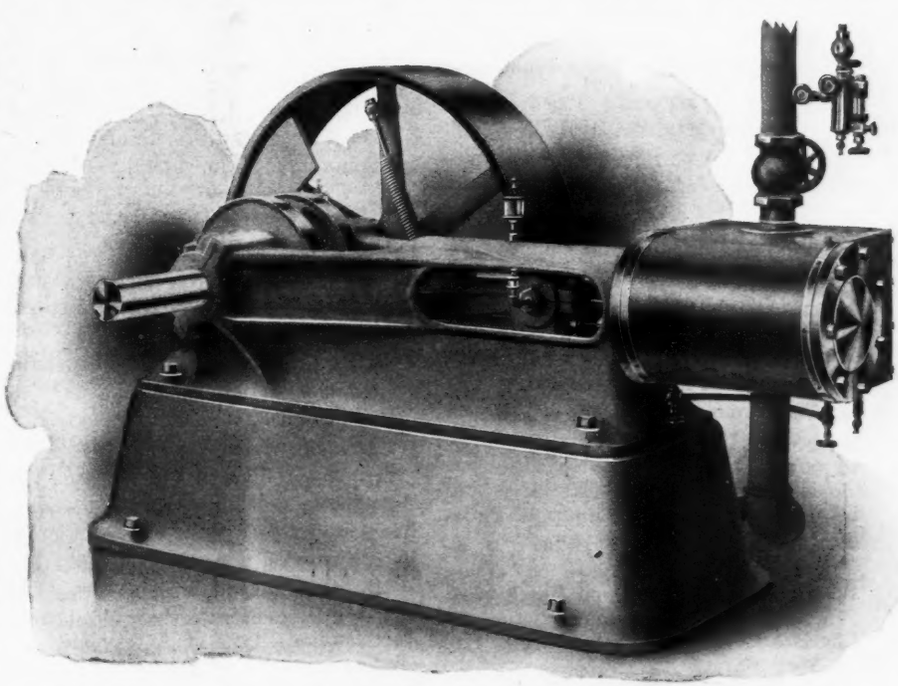


FIG. 2.—CYLINDER SIDE OF AN AUTOMATIC HIGH-SPEED ENGINE FOR DYNAMO DRIVING.

An Electrical Feature of the Military Tournament.

The Military Tournament which is to occur next week at Madison Square Garden, New York city, will include in its programme for several evenings a contest between the First and Second Signal Corps of the National Guard of the State of New York. This will partake of the nature of a pole climbing contest, the participants being equipped with linemen's climbers. The object will be to demonstrate the rapidity with which a telephone, telegraph or electric light line could be constructed by the members of the Signal Corps. A handsome cup has been offered as a trophy to the squad performing the feat in the least time.

American Bell Stockholders' Meeting.

The annual meeting of the stockholders of the American Bell Telephone Company will be held at Boston, on March 27. Besides the election of directors, the stockholders will be asked to authorize the conveyance of the company's entire real estate, ratifying the assignment to the American Telephone and Telegraph Company of the property of the company other than the company's Long-Distance stock, and distributing the shares of the Long-Distance company in exchange for the stock of the Bell company

Metropolitan Buys Third Avenue.

In a formal statement issued in the evening of March 19, Mr. H. H. Vreeland, president of the Metropolitan Street Railway Company, of New York city, announced that his company had purchased a "substantial majority" of the stock of the Third Avenue Railroad Company. The two roads will be merged and for the present will be operated by current generated at the Metropolitan Company's new power house at Ninety-sixth street and the East River.

The Franklin Institute.

Among forthcoming papers to be read before the Franklin Institute, at Philadelphia, are the following:

Fire Alarm Telegraphs, by Adam Bosch, of Newark, N. J., on March 27.

Modern Central Station Practice, by Charles F. Scott, of Pittsburgh, Pa., on April 10.

The Crown Woven Wire Brush Company, of Salem, Mass., is manufacturing a commutator compound that has met with great success in the dynamo and motor field. The company claims that it is one of the best commutator lubricants on the market, preventing the sparking of dynamo brushes.

OBITUARY.

James G. Smith, a pioneer telegrapher, and president of the Smith-Vassar Telephone Company, died on March 13, at his home, in New York city. He was born at Durham, N. H., in 1836, and entered the local telegraph office as a messenger boy at the age of 14. In 1881 he organized the Merchants' Telegraph Company, which was wrecked by the Grant & Ward failure.

Monsieur Emile M. H. Andreoli, the well-known electrician, chemist and writer, died last week. He was born at Besancon, France, in 1835. For many years he was London correspondent of numerous French and Belgian newspapers. One of his earliest inventions was the chloride accumulator plate. He has been lately closely identified with the practical application of ozone, and with electrolytic processes for the extraction of gold, his methods for the latter being in extensive use in the great mining plants of the Witwatersrand in the Transvaal.

Charles Henry Coster, of the firm of J. P. Morgan & Company, died at his home in New York city, on March 13, of pneumonia. Mr. Coster was born at Newport, R. I., on July 24, 1852. His whole business career had been spent as a merchant and banker. He possessed remarkable ability as an analyst of railroad properties. Mr. Coster was well known among electrical men and at the time of his death was a director of the Edison Electric Illuminating Company, and the General Electric Company, with both of which he had been connected for several years.

New York Electrical Society.

The 204th meeting of the Society, at the College of the City of New York, Lexington avenue and Twenty-third street, on Thursday, March 22, at 8 P.M., will be devoted to the discussion of the status of automobile development to-day, as shown in vehicles propelled by electricity, gasoline and steam.

Mr. A. L. Riker will speak on "The Advantages and Limitations of the Electric Automobile," giving a description of its construction and operation.

Mr. C. J. Field will discuss "The Present Development of the Hydro-Carbon (or Gasoline) Type of Automobile," including an outline of the industry in this country and abroad.

Mr. J. A. Kingman will review the history of "The Steam Carriage," covering the early types of steam automobiles, the present heavy English and French types, and the recently designed American light pleasure carriages.

Each address will be illustrated by lantern slides.

Wall Street and the Electrical Stock Market.

The future of the money market is involved in the operation of the new financial law which is regarded as the most important feature of the outlook at this time. If expectations concerning the law are realized, there is no doubt that a great increase in the country's circulating medium will occur. Should these expectations fail of realization, there seems to be ahead a protracted period in which the money market will be active and unsettled, and which may develop stringent conditions. The week in the stock market shows that neither the average speculator nor the investor cared to assume an aggressive position on either side regarding the new law. The market closed the week fairly active and with a firm tone.

On the New York Stock Exchange, General Electric closed the week at 125 bid and 127 asked, a gain of 1 point for the week. Metropolitan Street Railway, of New York, closed at 160⅝ bid and 161 asked, a loss of 3¾ points for the week. Third Avenue Railroad, of New York, closed at 68¼ bid and 68⅝ asked, a gain of 11⅞ points for the week. Brooklyn Rapid Transit closed at 66⅝ bid and 67 asked, a loss of ½ point for the week. Manhattan Railway, of New York, closed at 93⅛ bid and 93¼ asked, a loss of 1 point for the week.

On the Boston exchange, American Bell Telephone closed at 315 bid and no asked price, a gain of 3 points in the bid price for the week. Erie Telephone closed at 103 bid and 104 asked, a loss of 1 point for the week.

On the Philadelphia exchange, Union Traction closed at 36⅞ bid and 37 asked, a gain of ⅜ of a point for the week. Electric Company, of America, closed at 11¼ bid and 11½ asked, a loss of ¼ of a point for the week.

On the curb or outside market in New York, Electric Vehicle closed at 25 bid and 32 asked, a loss of 4 points for the week. Electric Boat closed at 17 bid and 18 asked, a gain of 2½ points for the week.

Wall street, March 17.

Independent Telephone Rumor.

It was rumored in Wall street on Monday of this week that the Telephone, Telegraph and Cable Company of America was directing its efforts toward acquiring the City and Suburban Telegraph Association, the local Bell telephone company at Cincinnati, Ohio.

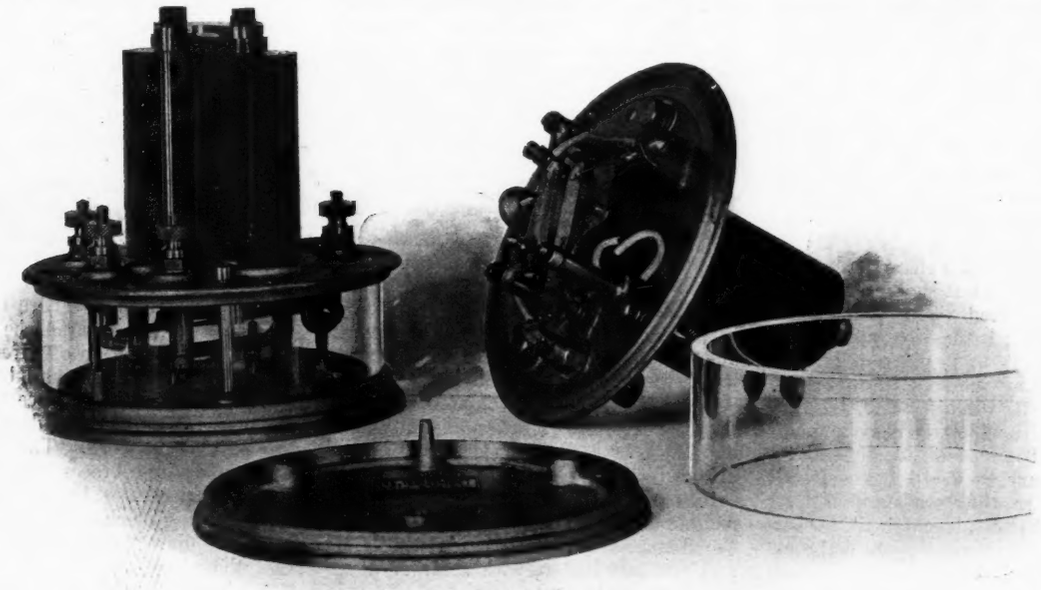
Chicago Electrical Association.

The next meeting of the Chicago Electrical Association will be held at Room 1741 Monadnock Building, on April 6, at 8 P. M. Professor I. J. Macomber, of the Armour Institute, will read an address entitled "Laboratory Methods."

A Relay for Railway Switch Signals.

On block-signal work in railway operation the unauthorized adjustment of relays has caused many failures of automatic signals in the ordinary form of relay contacts heretofore employed. The effect of dust and dampness within the relay box has also been a fruitful and productive cause of failure. The type of relay illustrated herewith has been designed to obviate so far as possible the difficulties alluded to above, and incidentally to embody the salient features of many improvements in such apparatus which its maker, the Union Switch and Signal Company, of New York, has hitherto employed. As will be seen from the illustration, the complete relay being represented on the left and its three parts on the right, the mechanism is tightly enclosed in a dust and airproof glass sided case, so that the instrument may be used in damp air or even in battery wells and other places where ordinary relays with open contacts are found unserviceable. The instrument is adapted to be sealed up by an inspector when put into service and no adjustment whatever can be made without breaking the seal. This forms an admirable means of detecting any unauthorized tampering with the instrument. By reason of the glass case surrounding the working parts they are clearly visible at all times.

The armature pivots run in glass bearings, thus eliminating the necessity for lubricants and producing immunity from fusion and sticking of armature bearings by lightning discharges. Each coil of the magnet may be tested at will from the exterior or may be renewed or removed without danger of breaking the inside wires. Carbon or platinum contacts may be used as desired, the design permitting these to be interchanged at will. All of the contacts are of the sliding type and consequently keep themselves clean and bright in use. The instrument shows every evidence of careful design and satisfactory adaptation for the difficult use to which it is put.



A Relay for Railway Switch Signals.

Telephone and Telegraph

The new telephone system, known as the Citizens' Telephone Company, of which Frank N. Sherman is the principal promoter, has nearly completed its line in Watertown, N. Y., and in a few days more the new system will be put into operation. The inauguration of the new company will see the beginning of a telephone rate war.

The Telegraph, Telephone and Cable Company of America, the rival of the Bell Company, it is announced, has secured a local foothold in Pittsburgh, Pa., by purchasing the controlling interest in the Home Telephone Company, which recently secured franchises in Allegheny. This is the only line it has been able to buy as yet, although every effort has been made to secure other lines.

At a special meeting at Albany, of the stockholders of the Hudson River Telephone Company, it was decided to increase the capital stock from $2,000,000 to $3,000,000, to consist of 30,000 shares at a par value of $100 a share. The increase in the capital stock is to finance the extensive improvements and changes contemplated. The additional expense will be almost wholly for equipment.

In the matter of telephone development Japan compares favorably with other countries. Several of its large cities have a number of subscribers. Tokio has about 5,000, with 4,000 on application at the last report, and a new exchange is being built with a capacity of 6,000. The subscribers last year in other cities are returned as follows: Osaka, 1,600; Yokohama, 1,002; Kobe, 843, and Kyoto, 520. The subscription rate in Tokio is $33 a year, and 15,000,000 messages were sent over 900 miles of wire in 1899. The government is spending $1,000,000 this year on new telephone work.

W. J. Rainey, the well-known coke producer of the Connellsville region, has just won an important suit from Oliver Brothers, of Pittsburgh, in which the decision carries with it the judicial assertion that a contract over the telephone is legal and binding. It was claimed in the Oliver suit that the contract for a certain amount of coke was made over the telephone, the understanding being that the contract would be made in writing later. The coke was to be used at the Oliver & Snider furnaces and, it is claimed, did not equal the expectations of the purchasers, and they refused to pay in part. The difference amounted to about $8,000. Mr. Rainey contended that the telephone contract was just as binding as though it had been followed by a formal letter. He got judgment for his claim.

NOTES ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.

BY EDWARD C. BOYNTON.

(*Continued from page 265.*)

The use of electric locomotives for the purpose under consideration depends upon several conditions. If the travel is heavy, that is 2,000,000 passengers per year and upward, the service frequent, the speed high, requiring an average train of four cars, and, as may be the case, the same coaches must go much further than the electric service extends, hauled by steam, it is advisable to use the electric locomotives hauling standard coaches. Their principle advantage lies in their ability to perform the work of a steam locomotive in every respect, and this is frequently a strong point in their favor with the railway managers. They are thus able to accommodate themselves to congested traffic which usually occurs on holidays and possibly at certain times every day, by simply increasing the number of coaches hauled, as is the practice with steam locomotives. Such locomotives should weigh from 100,000 to 150,000 pounds, should have eight wheels and four motors, so that the total weight is available for traction. They must be provided with sufficient power to haul at least double the average train without over-heating. They must not only be able to perform the work of a steam locomotive in the same service, but should do it at a faster schedule speed. The rapid acceleration of a train hauled by such a locomotive enables it to perform the above duty without any increase in the maximum speed. In switching cars, the ease and rapidity with which the electric motor can be handled is a great advantage.

It is necessary to equip these electric locomotives with the best automatic air brake system that can be obtained, for several reasons. They must operate the existing brake system on the coaches as well as the steam locomotive does. The law requires automatic brakes and a whistle. An independent motor compressor with a large main reservoir is therefore almost imperative.

The cost of repairs on an electric locomotive should be exceedingly low, possibly 10 per cent of that required by a steam locomotive on account of the fewer moving parts and the entire absence of the boiler and its necessary equipment.

The fact that an electric locomotive requires but one set of controlling and air braking apparatus is a distinct advantage over other methods of employing electric motive power. This is evident, not only in the first cost, but in the fewer parts to be cared for.

The second method of applying electric motive power to an existing steam railway; the equipment of standard coaches as motor cars, will appeal to all steam railway managers as the cheapest and most convenient way to make the change. This method has strong arguments in its favor.

The motor car carries its own paying load and during the hours of light travel can be run light, without hauling other coaches. A standard coach equipped with two motor trucks and four motors will haul nearly as many coaches as the electric locomotive above mentioned and will weigh 100,000 pounds. It will easily handle five coaches making a six-car train weighing, loaded, 450,000 pounds. I believe that the power consumed per passenger carried in a train hauled by an electric locomotive will be less than if all the cars were motor cars, whether run singly or in one train.

Let us see exactly what must be done to a standard coach to equip it as a motor.

In most cases the conditions will be found to be such that three or four-car trains with a proper schedule will be sufficient to take care of the maximum traffic. This necessitates only two motors for the coach. These should both be mounted on one truck, and this truck complete with motors will have to be purchased and used to replace one of the standard trucks. The motor truck should be built especially for the purpose, a heavy steel truck, 36 to 40-inch, steel-tired wheels, brakes of the type that do not require brake beams, springs both elliptic, and equalizer of sufficient strength to support the weight of half the car body with maximum load, and this means all standing room occupied. The size and general design of the axle in the motor truck must be carefully considered. The author does not believe that steel axles, five inches minimum diameter between wheels, are safe. It may be that in calculating their strength and considering the enormous strains which they must withstand, the result appears satisfactory, but experience shows that the excessive vibration at high speeds will cause crystallization of the steel and a high factor of safety must be employed.

The wheel journals should be at least five and one-half inches by nine inches, and the diameter of axle between wheels six and one-half inches, with a larger diameter through the axle gear.

The wheel base can not well be more than seven feet, on account of the curves, but it is nearly all needed in order to obtain room for motors of sufficient size. The motor should not be supported by the truck frame in any way.

Steel bars should be placed at each side of the motors extending from one axle to the other, and beneath them, just inside the wheels. These should be suspended from lugs on the motor frame by suitable links as near the centre line of each axle as possible. The backs of the motors can then be carried on these bars by means of other lugs on the motor frame and springs above and below the lugs. This method of motor suspension is rapidly coming into general use and it has many advantages. If motors should be damaged it is simply necessary to place another pair of wheels and axles with other motors in the same truck frame. The motor cars ride much easier, or practically the same as before they were equipped with motors, due to the fact that the jarring of the motors is not transmitted to the car body.

The motor car must be wired for, and furnished with, a suitable number of electric lights and heaters, which is a simple matter. The same thing must be done for the coaches it is proposed to haul. The latter should also be equipped with collecting shoes connected by a wire which terminates at each end in an electric coupler of sufficient capacity to supply the motors on the motor car if necessary. The motor car is supplied with the regular air brake apparatus used by the road and piped as a steam locomotive, except that the car is double ended and requires an engineer's valve, gauge and other necessary parts at each end.

The independent motor air compressor, main and auxiliary reservoirs, car wiring cables, main wires for collecting-shoes, rheostats and electric couplers, all go under the car in addition to the standard equipment of a passenger coach.

A small cab should be provided at each end for the motorman, preferably inside the car, fitted with a front and side window which can be opened to their full extent. Here are located the air-brake valves, the automatic governor and switch for the compressor, the motor controller, main switch, circuit breaker, electric light and heater switches. The bells or gongs, pilots and whistles at each end complete the list.

A few words about car wiring may be of interest here. The most careful work in wiring cars is very essential. The author believes that the causes of nearly all the fires occurring in motor cars can be traced to defective wiring. There is no reason why such wiring can not be made safe. Even if the insulation of wires and cables is of the best, they should be treated as bare wires, as the insurance underwriters say, and unskilled labor does not pay in this part of the work. The maze of iron pipes, rods and braces under such cars render it necessary to protect the wires from rubbing or chafing, with the utmost care. It must not be taken for granted that the pipes, etc., remain in one position when the car is under headway. The working and straining of the car body, the swing of the trucks and brake rods and compression of springs must be carefully considered, and no care in protecting the wires, however great, can make them too safe. In trolley cars the removal of the pole from the wire will put out, or render a fire easy to control, but in such cars as are under discussion, I have not yet seen or heard of a method of cutting off the current at or near the contact shoes, though there may be such. It is evident, therefore, how helpless a train crew is when called upon to put out a fire caused by a terrific arc under the car. It has been proved in practice that good car wiring practically prevents such accidents. Before leaving the equipment question I will give some opinions on the performance of the motors.

For such short distances, and the intermittent work required, the modern railway motor seems well adapted. It can be overloaded, 100 per cent frequently, without injury, for a short time. Most types of these motors have but one or two serious faults. One is lack of sufficient ventilation. During hot weather this

becomes a serious matter, and one that should be corrected by the manufacturers. The design of the axle bearing is another. In street-car work, the plan of using a gun metal lining in halves, lubricated by grease or oil, is fairly satisfactory, but where these bearings each become 15 inches long and six and one-half inches diameter; at speeds of 40 to 60 miles per hour, the conditions are different, and while giving little trouble, the cost of repairs seems unnecessarily high. Most of the motors are similar in design to the ordinary street-railway motor, entirely enclosed by the frame, and intended to run in the mud and slush of a city street. On the other hand a steam roadbed is usually dry and clean, the motors are further above the ground, and water rarely flies above the axle. It would seem, therefore, that they could be more open on top. It has been found necessary to run through the hot Summer months with the large covers over the commutators removed. The construction, and especially the insulation of armatures, has reached such a degree of perfection that a burn-out is seldom heard of in the larger motors.

I have had under my personal observation a considerable number of such motors, some of which have been in service over two years, making a daily mileage of over 300 miles, and have never had one armature burn out. In one case a pair of motors were in service eight months, including a Winter. No repairs whatever were made during that time beyond the ordinary daily inspection, cleaning and renewal of carbon brushes.

In another case a pair of motors made upward of 100,000 miles after being put into service, the only repairs being renewal of armature and axle brasses, gears and pinions. As is well-known a frequent cause of burn-out in the past has been due to the wear of the armature brasses, allowing the armature to strike the lower pole-pieces. This cause has been eliminated by making the clearance between the pole-faces and the armature slightly greater, possibly at the expense of an increase in weight of copper on the field magnets, and with no apparent loss in efficiency.

The total weight of a 60-foot standard coach, equipped as a motor car with two motors, will be about 80,000 pounds, without passengers, of which 55,000 pounds are on the drivers or motor truck. The speed of such a motor car running light, if geared sufficiently high, is probably only limited by its weight and the quality of its track and roadbed. With a stone ballasted track, 100-pound steel rails, few curves and those of long radius, a heavy car with the best steel tired wheels should run 100 miles per hour at full speed without difficulty.

I have mentioned a four-motor car consisting of a 60-foot car body weighing 100,000 pounds complete. This represents about 800 horse-power nominal rating of the motors at 650 volts direct-current, and this is the maximum horse-power that can be placed under a standard coach, on trucks and wheels which do not necessitate any other changes in the existing standards of steam practice. The motors are capable of exerting double that power for a short time. The total cost of converting a standard coach into a motor car with two motors is about $3,800.

The third method of using electric traction in steam service, that of the use of light motor cars and trailers, built for the purpose, has some advantages. The former coaches can be used elsewhere on the system as are the locomotives. The smaller, lighter cars are cheaper to construct, the wear on the track is less, and there is considerable economy in power. It has been proposed, and no doubt will come, that such cars will run through the principal street of a city, on the existing street car track, before starting on their trip over the steam track. This would necessitate either a trolley wire over the steam track, instead of a power rail, or both collecting shoes and trolley pole on the car. There is no question but that this may prove a great advantage in time. On the other hand, the cars must be used exclusively on the line equipped with electric power. At speeds of 50 to 60 miles per hour, which *must* be made in order to compete successfully with the existing parallel trolley lines, the cost of maintenance and repairs due to the excessive vibration will undoubtedly be greater than that with standard coaches.

The economy in power due to the reduction in dead weight hauled is of considerable importance, not only on account of the smaller amount used, but the line conductors can be lighter, greatly reducing their cost, or the system can be extended to longer distances at no more expense for transmitting the power.

In the future there may be a decided tendency to reduce the weight of electric trains. In other words, it will be an attempt to handle a constantly increasing traffic with a lighter equipment in order to haul less dead weight per passenger. The engineer who proposes to introduce such changes must move with the greatest care in order not to save the weight at the expense of strength. It should never be forgotten that the maximum load is "no standing room," that the strains on a car and its trucks running at 60 miles per hour over a steam track which may be made of 70-pound rails with joints none too good, are not to be compared with such as are met with in a city street at low speed. An interesting problem in connection with a similar equipment has arisen within the last few years, and the time is rapidly approaching when it must be solved. It relates to the difference between the wheels of street cars and the steam railroad coaches. Though both use the standard gauge of four inches by eight and one-half inches, the average street car wheel has a tread two and one-half inches wide and a flange three-quarters of an inch deep, while the master car builders' standard requires a tread four inches wide and a flange one and one-eighth inches deep. The problem is a serious one, for it intimately concerns the safety of the train. The steam railroad people after 50 years' experience have settled upon the above standard, and the electrical engineer who chooses to ignore their experience in this, and in many other cases, runs a risk. There should be no doubt that it is unsafe to run the small street car wheels at high speeds over steam railroad tracks, with their present form of frogs and switches; and it is, in fact, impossible to run them on steel rails weighing 90 to 100 pounds per yard on account of the wide spaces in the frogs. The question may be asked: "Is it not safe to run such narrow wheels on the steam track if the latter is kept carefully to gauge, and proper frogs for these wheels are substituted for the existing ones?" If this is done steam trains can no longer run on the road, and, as it is necessary in order to round a curve at high speed with safety, to spread the gauge from one-quarter of an inch to one-half of an inch, the danger is greatly increased. On the other hand, the master car builders' wheels can not run on the existing street car tracks in our cities. The flange is too deep for the frogs, the size of the groove on the inside of the straight rail is larger than the city authorities would sanction, and the outside portion of the tread would in many cases run on the pavement and crush it down to a level with the top of the rail. The only solution of the problem seems to be a compromise wheel with about three-inch tread and one-inch flange. Whether or not this is safe, only time can tell.

The fourth question, that of hauling freight by electric power, should, of course, be decided upon at the time of installation, as it may cause considerable difference in the plans for power stations and line transmission. As the question can only refer to local freight along the line electrically equipped, it is of doubtful importance as applied to the conditions under discussion. If the freight traffic on such lines be sufficiently heavy to necessitate the use of a locomotive for several hours during the hours between midnight and morning, when there are few if any electric passenger trains in service, it is economy to use an electric locomotive, for it costs but little more to run the power station if it has been shut down, and the total expense would be somewhat less than that of a steam locomotive. The whole question of transportation of freight by electric power is one which concerns the future more than the present.

When the time arrives that long distances are electrically equipped on our steam railways, then it becomes far more important.

POWER TRANSMISSION.

Feeders.—The transmission of electric power forms the most important part of the problem of the electrical equipment of a steam road. At the present day our railway motors all require the direct current, and we are therefore limited to its employment in the working conductor. By increasing its voltage from that usually employed to 700 volts, a considerable advantage is at once gained, and without additional expense in motors or

generators. Experience has shown that the economical radius of operation of a power station generating such a current and delivered to the line without feeders is from 10 to 12 miles. This refers to a heavy train service with a fairly frequent schedule, and an average load of 500 amperes on each radial line of single track.

By the line or working positive conductor is here meant a steel rail of 90 to 100 pounds per yard, well bonded, and equal in conductivity to about 1,200,000 circular mils of copper. This statement, "without feeders," may be wondered at and a few words of explanation will be necessary.

It should be remembered that the conditions are very different from a street or elevated road. There may be only two or, at most, three trains running. The greatest fall in potential occurs when a train is leaving the further end of the line, and this may be somewhat less than three-quarters of a volt per ampere at that point, while the average efficiency of the line is over 75 per cent. Again, even if the loss in the line becomes greater through an attempt to increase the number of trains, or to extend the line, the question of feeders depends almost wholly on the cost of fuel. If the interest on the cost of feeders is greater than the saving in fuel consumption effected by their use, and a satisfactory train schedule can be maintained without them, it can not be in the interest of economical operation to provide them. It has been said that such feeders, in connection with a so-called booster used to overcome the drop in the feeders and a consequent decrease in their weight, are the most economical. Such an arrangement is undoubtedly cheaper as regards first cost, but I have seen no data showing the cost of maintenance and depreciation of these additional machines, as compared with the cost of a feeder of sufficient weight to perform the work without the booster, and on which there is practically no depreciation. Whichever method is followed, the cost of feeders for such a road will reach many thousands of dollars, and railway managers will make the most rigid investigation of traffic conditions, present and prospective, before deciding upon such an outlay.

The above statement should make intelligible the reason why 10 or 12 miles is considered the maximum radius of operation of a station delivering 700 volts direct current. It is hardly necessary to add that a larger system extending over greater distances should be supplied by multiphase generators, and a high-tension transmission line, combined with the usual rotary converters, located at suitable points on the system. In the absence of a practicable alternating-current railway motor, the above system is the only one—there is no choice.

In regard to the most economical material to use as feeders, the extremely variable prices of both copper and steel renders it difficult at present to come to a satisfactory decision, but with both metals at what we may call their normal values, steel is cheaper and more satisfactory. The author believes a proper feeder for 700 volts direct current should be made of flat steel bars about one inch by five inches section, two of which are placed side by side, bolted together with alternated joints and supported on edge in the slotted tops of small posts set in the ground at the side of the roadbed, not over two feet high and boxed in. At grade crossings the break in these feeders must be bridged by either an underground or overhead connection. In yards and stations where there is a multiplicity of tracks it will be frequently necessary to carry them overhead for considerable distances. Copper is of course used in such cases.

The Working Conductor.—In considering a train service consisting of heavy trains running at the speeds mentioned, the trolley wire as a working conductor will probably not come into general use, although it is used for such a service today. The cost of construction, maintenance and depreciation is greater than that of a third rail. It has few advantages, and many disadvantages for such a service. It is now generally conceded that an insulated rail placed close to the track answers all requirements, and the author's experience shows that it is satisfactory. It is difficult to understand, however, why the common form of T-rail is so generally used for this purpose unless it is due to a desire to save money by using up old rails. A more inconvenient cross-section for thorough and efficient bonding could hardly be selected. It will be admitted by all that this conductor should be so bonded that when worked at its full capacity there should be no greater loss at the joints than elsewhere. There are a number of standard commercial forms of rolled steel which are no more expensive than T-rails that are well suited for this purpose. A form that will permit the use of one or more thin copper plates of ample area of contact held at the joints between a steel splice-plate and the conductor by heavy pressure obtained by the use of a sufficient number of bolts, is an inexpensive and satisfactory bond. The rule that the bond shall be equal in carrying capacity to the conductor, and the area of contact equal to or greater than the cross-section of the conductor is a safe one to follow.

One question which has been studied with care is of great importance in this latitude, and that is the effect of ice on the contact surface, and how to get rid of it. Many experiments have been tried, and few can be said to have been successful. A further possible advantage of the use of some other form of rolled steel might result in the complete elimination of this trouble. I refer to the collecting shoes having a side or under-running contact. This would allow the partial roofing over the conductor by wood, which would thoroughly protect it from the weather.

Ordinary snow-storms and even blizzards do not interrupt the service. I have seen a storm which tied up nearly every wheel in a nearby state, but the electric service was the last to succumb, and even then it was not on account of the conductor rail, or too much snow on the roadbed, but from a train running off an ice-choked frog. It has been demonstrated that motor coaches equipped with proper steel brushes for the third rail, and snow plows can go through as much snow as an ordinary passenger locomotive. Their great advantage lies in the fact that they can run through deep snow slowly, due to the enormous torque of the series motors and the absence of reciprocating parts. But when the temperature of the conductor rail is below freezing point, and it begins to rain, as is not infrequently the case, a coating of ice forms on the contact surface which closely resembles enamel. No mechanical method has been found to completely remove this.

As to chemical methods, certain roads can and do use salt or brine. It is not considered advisable to salt the roadbed of such a road as is under discussion owing to the danger of leakage should the track become flooded with water. When applied at the right time, an oil which does not solidify at a low temperature is sometimes successful, but the difficulty of applying it to the whole road at the proper time can be appreciated.

Insulation.—The question of insulating the positive rail of a 700-volt grounded circuit has in actual practice been developed to such an extent that the results obtained are remarkable, to say the least. If such methods as are now in use had been proposed 10 years ago, they would have been regarded as impracticable.

For years it was the custom to consider the ground a conductor of electricity. It was, of course, realized that the service rails must be bonded in some way, but the ground was considered to be a great aid to the rails in returning the current. I do not propose to deny that this is true in a crowded city, where there are thousands of tons of iron pipes buried but a short distance beneath the rails, but can we call this a ground return? My experience shows that the roadbed of a steam road, consisting of sand, gravel or rock ballast, when dry, is a good insulator, and when wet there is but little difference. A rock-ballasted track in particular needs no insulation whatever except the wooden ties.

I am aware that such a statement may be regarded with doubt, but perhaps it may be made clearer if we take all things into consideration. The road runs through an open country, the soil is of the average composition, some of it wet, but most of it dry. If we stand on a wet spot and place our body in circuit from positive to ground we receive a shock, perhaps of maximum voltage. This would apparently show the ground to be a conductor, but a little thought will prove that it conducted a few milli-amperes only. If we stand in dry earth or on a tie we feel no shock. But the one test that proves the insulation of such a line is the leakage test. From tests made every night for over a year the leakage averages one-half ampere per mile in dry weather to one and one-quarter amperes in wet weather, and I am convinced that nearly all of this is in the underground work necessary at grade crossings and

switch points. The above refers to a rail insulated upon creosoted wood blocks attached to the ties. A complete covering of snow has little or no effect on the leakage. The form of the positive rail may influence the leakage somewhat. For example, the inverted V form acts as a roof to shed water and keeps the contact surface between the block and rail dry. But there is in use several miles of ordinary T-rail as a positive conductor, laid on blocks of wood one and one-half inches thick attached to the ties, not creosoted. but dipped in an insulating compound.

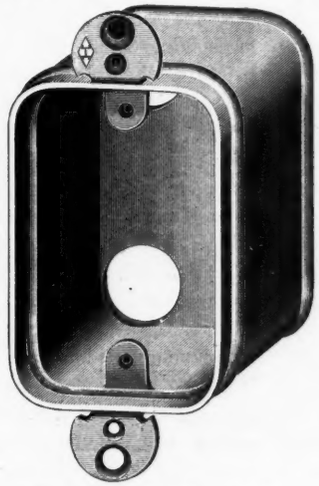


FIG. 1.—STEEL WALL CASE.

No leakage is noticeable here. We can easily understand that if any appreciable amount of the current in amperes should leak through these blocks, whether prepared or not, they would burn up. The writer, therefore, believes that such insulation of the positive rail for the current and voltage under discussion is ample, and much expense can be saved by steam roads by its use.

Track Bonding.—One of the most necessary and at the same time most expensive parts of the work in changing existing steam roads into an electric line, is the bonding of the service rails. The author believes he has done some of the heaviest bonding in the country and is of the opinion that there is no satisfactory method of bonding a T-rail at present. When such bonding costs $2 per joint it becomes a very serious matter. Bonding around the angle plate with the bonds about two feet long is out of the question, for the cost of copper would be too great, and it would be exposed. Riveting the lugs on the bonds through the web of the rail is not good practice, because to secure sufficient area of contact four holes would have to be drilled in the ends of each rail, which so weakens it as to render it unsafe. The shortest possible bonds should be used under the base of the rail. It requires four one-inch holes in the base of each rail, and we can easily see how unsatisfactory and expensive this is, with four bonds of 300,000 circular mils area for each joint of 100-pound steel. In nearly all rail bonds the principal resistance is in the contacts. It is a simple matter to use sufficient copper, but to secure a proper contact is a difficult problem. The bonds must have the utmost flexibility to withstand the vertical motion of the rail ends, and even then many of them will gradually break off, strand by strand. What is urgently needed at the present day is a cheap and efficient bond for a T-rail. Such a bond, to be satisfactory, must show no greater fall in potential than an equal length of the rail itself, when the maximum current is flowing through the joint. On account of the fact that the ground is practically of no value in augmenting the conductivity of the return circuit, the entire circuit must be regarded as metallic, and the ground should not enter into any calculations.

Power Stations.—The writer does not propose to enter into the subject of the design and arrangement of machinery in a power station for a steam road, as there are no engineering features which differ from those encountered in such a station intended for a large street railway. An abundance of water and cheap fuel are of course important points. Such

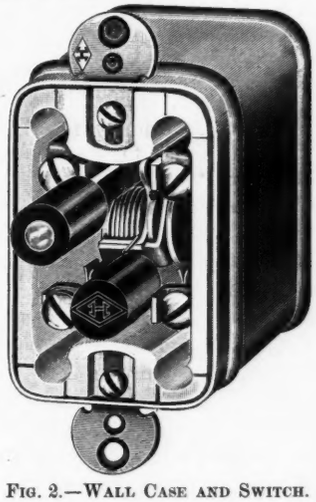


FIG. 2.—WALL CASE AND SWITCH.

power stations can be built for from $80 to $90 per kilowatt, exclusive of the land.

A few words about the amount of power required may be of interest. An important figure is the amount of power delivered at the switchboard per train mile. It eliminates all losses due to resistance of circuit, and current used for air compressors, electric lights and heaters. This figure will vary from four to six kilowatt hours per train mile, reaching its maximum in December and January, due to the longer hours of lighting the cars, the constant use of electric heaters, and the frequent running through snow.

(To be concluded.)

Charles J. Wilderman, of Paterson, N. J., was arrested the other day while driving a wagon loaded with trolley wire. In the police station he confessed that he had cut the wire from the White Line, at Clifton, during the night. He also confessed that he had cut wire in 13 different places in the last two months, stripping the poles for miles in each instance, and implicated several other men, whose names he gave to the police. The value of the stolen wire is about $5,000.

Novel Designs in Electric Light Fittings.

The wall-case and switch and the new type of lock switch and key here illustrated are interesting accessories for a well-designed system of electric light wiring.

The wall-case is made of steel, rolled cold and galvanized. They are intended for use on old walls, in wood-work or wherever a suitable receptacle is not provided for the switch. As is shown in Fig. 2, the switch for which they are designed is of the double push variety. The plate covering these wall cases is recessed for the reception of the attaching ears, which do not, on this account, require to be set into the wall. Fig. 3 shows a lock switch and its key. This switch resembles the regular switch in every particular, except that the buttons are not used, and the ends of the lever to which the buttons are ordinarily attached are adapted to engage the end of the key, which does not touch any current-carrying part. The switch is operated by pushing the key into one of the other of the keyholes, which are of such shape that nothing but the key adapted for them will operate the switch.

The face-plate over this switch is fas-

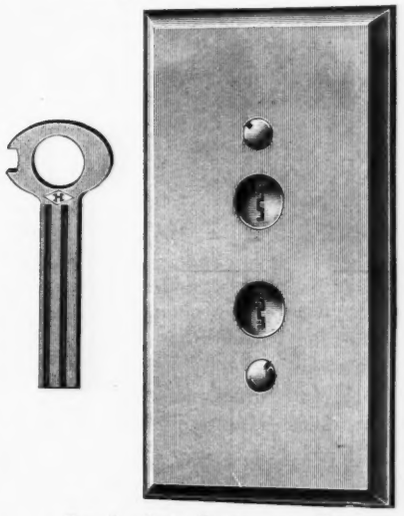


FIG. 3.—LOCK SWITCH AND KEY.

tened with screws which cannot be moved with an ordinary screw-driver. Instead, the head of the key contains a recess which engages with two slots in the screw-heads, so that it is necessary to use the key to open the switch. These switches and cases are made by the Hart Manufacturing Company, of Hartford, Conn.

Rufus H. Sawyer, of Malden, Mass., has been appointed receiver of the White River Valley Electric Railroad, which is being built from Bethel, Vt., to Rochester, Vt.

EXPORT NOTES

Information just received in this market says that the Hawaiian Electric Company, Limited, of Honolulu, are to shortly be in the market for one 75-ton compound condensing engine compressor, with condensing coils and coils for one 10-ton ice tank. They are also shortly to purchase a 30 tons per day boiling and distilling plant.

Application for a charter has been made by the newly incorporated Electric Light and Cold Storage Company, of Hilo, Hawaii. The capital is $200,000, with permission to increase it to $500,000. Considerable machinery, etc., is to be bought at an early date by the company. Mr. Charles H. Fairer, of the firm of H. Davies & Company, Limited, of Hilo, is the secretary of the above named company.

The Limerick, Ireland, Corporation, at its last meeting, decided to await the expert's report prior to allowing the engineer of the Shannon Water and Electric Power Company, Mr. S. G. Fraser, to spend the proposed $2,500,000 on a power house at Doonas. When the report is ready and passed upon it is believed considerable material will be required for the extensive undertaking, which will include large quantities of electrical machinery.

The Buenos Ayres and Belgrano Electric Tramways Company has according to advices from London, England, placed a large portion of its $1,000,000 second debenture stock. The proceeds of this issue are required to complete the electric equipment of the company's system, to provide for expenditures on new lines and increase its rolling stock. This, it is believed, will bring many new orders to this market for the required material.

The Argentina Congress has passed a law for the development of the port of Rosario. The improvements contemplated are to be completed within five years. They comprise the establishment of 10,000 feet of docks, capable of accommodating vessels drawing 22 feet of water, as well as the construction of grain elevators, railways, hydraulic cranes, etc. An electric light plant will also be erected. Bids for the various undertakings will shortly be asked.

Mr. Gustav Schimpff, an engineer of the Prussian Government, has arrived here from Berlin, Germany, and, while in New York, will be at Luyties Brothers, No. 73 Park Row. His visit to this country is for the purpose of studying electric tramway systems and other railway constructions. Mr. Schimpff claims that there is a great future in Germany for American electrical railway equipment and machinery. His investigations will be of benefit to the manufacturers of this country.

An export firm in New York city is asking for prices on two large water-wheels from requisitions received from Barcelona, Spain. There were also included in the estimate asked some other pieces of machinery for electrical purposes. Lack of direct representation in Spain by American manufacturers, it is said, compels importers in that country to purchase many lines of manufactured goods made here through British and German concerns who have agencies in some of the Spanish commercial centres. The little direct shipments now under way from here to Spanish ports is entirely sent by export merchants.

The Honolulu Rapid Transit and Land Company, of Honolulu, H. I., whose local agents are W. H. Crossman & Brother, No. 77 Broad street, New York, have lately been making extensive purchases in this market. The road is to be 20 miles long, and is to cost, including buildings, equipment, etc., about $600,000. The construction of the power house and car barn has begun, and the building of the road is to start upon arrival of the material, which is expected to be either in May or June next. At least 10 miles of the line are expected to be completed by December next. Among some of the contracts already placed are those of 3,000 tons of rails given to the Pennsylvania Steel Company. The generators and motors have been bought from the Westinghouse Electric and Manufacturing Company. The American Car Company are to furnish 27 cars. The Duplex Car Company are to send eight cars. J. G. Brill Company car trucks are to be used. Three Hamilton-Corliss engines of 300 horsepower each are to furnish power, and three 260 horse-power Babcock and Wilcox boilers are also to be used. The Diamond State Steel Company is to furnish a considerable quantity of rods, bolts, spikes, etc. Mayer & Englund furnish the copper bands, and Milliken Brothers have sold $267,900 worth of steel trusses, and a smoke stack is included in the amount stated. Mr. C. G. Balentyne, the manager for the road, has made frequent visits to this country during the past year. This, it is stated, is only one of the many electrical undertakings which is being carried to completion in the Hawaiian Islands. Another important work which is shortly to be started is the Kohala & Hilo Railway. This company proposes to build from Hilo, Island of Hawaii, northerly through the Hilo and Hamakua districts to Kohala. In all the road will be some 130 miles in length.

Electrical undertakings in Italy are to-day said to be making greater progress than those of any other country in southern Europe. Below are the names of some of the new concerns that have just been organized, and which are to invest extensively in machinery and other manufactured articles for their undertakings: La Societa Cooperativa Elettrica Saronnese is the title of a company which has been formed at Saronno (Busti Arsizio) to establish an electric lighting plant. They are to invest upwards of $50,000 in the undertaking. Application has been made to the Italian Ministry of Public Works for a concession to construct and work an electric tramway in the town of Ferrara. A new company has just been formed in Milan, to be known as La Societa L'Unione Telefonica Lombarda, which has a capital of $700,000. A large portion of the capital is to be invested in instruments and other appliances. La Societa Italiana di Elettricita gia Cruto, of Turin, is increasing its capital to $1,000,000, with the object of making extensive investments in railway equipment. As there are extensive water-works in Italy electric railroads are to make use of such power. Among these may be mentioned the electric road to be established between Mont Dauphin and Torre-Pellice, in the north of Italy, passing over the Col Lacroix. This project has been under discussion for some time past. The expense was formerly estimated at 70,000,000 francs, but by the utilization of water-power this may be reduced to 30,000,000 francs. The road is to have a total length of 70 kilometres, including a number of short tunnels. The Italian Government is considering the introduction of electric traction on its railroad system. The first trials are to be made on the line Milan-Monza, a length of 13 kilometres, on the accumulator system. On the line Bologna-San Felice, accumulator cars carrying 60 persons will be used. The Mediterranean Railway Company has proposed to apply electric traction on three lines radiating from Milan, and the work has already been commenced; the current will be furnished by a hydraulic plant of 18,000 horse-power, situated at Tornavento, on the river Tessin. The three-phase system will be used, and the current will be carried at 10,000 volts to the railroad, where it will be transformed by seven sub stations to direct-current at 700 volts. The third rail system will be used.

INDUSTRIAL NOTES

The Electric Appliance Company, Chicago, are anxious to have the names of alternating station managers who have not received a copy of their little pamphlet describing Guttmann wattmeters.

The Western Electric Company has recently installed for Carson, Pirie, Scott & Company, a 150-kilowatt, 125-volt generator. A generator of the same size was also installed for C. F. Gunther, of Chicago.

The factory of the "New Excelsior" dry battery has been moved to 193 Greenwich street, New York, and a change in management has occurred. Messrs. Solman & McShane are at present proprietors.

The Berlin Iron Bridge Company, of East Berlin, Ct., has opened an office in the Stephen Girard Building, Philadelphia. The office will be in charge of Mr. L. H. Brumbaugh, who has been with the company for a number of years.

The Emerson Electric Manufacturing Company, of St. Louis, Mo., announce that prompt shipments of Emerson 1900 model fan motors and ceiling fans can be made by the Western Electrical Supply Company, of St. Louis, Mo.; the California Electrical Works, San Francisco, Cal., and the H. C. Roberts Electric Supply Company, Philadelphia, Pa.

The new lamp bracket having hard porcelain fittings for outdoor use that has recently been put on the market by Schiff, Jordan & Company, of 259 Greenwich street, New York city, has met with great success. The company reports that it has been adopted by many of the leading lighting companies throughout the country. Its special feature is imperviousness to moisture.

The city of Erie, Pa., offers free, to any manufacturing interests locating there, 100 acres of very desirable land with excellent railway facilities, provided its factory shall employ 1,000 men. Also 10 other similar locations, all central as to good railway facilities, are offered on similar conditions. Douglas Benson, secretary of the Board of Trade of Erie, Pa., has the matter in charge.

The friends of the American Electric Telephone Company are congratulating that company upon the successful issue in the Carty bridging bell suit. This suit was brought against the Anthracite Telephone Company, using apparatus furnished by the American Electric Telephone Company, and the decision sustains the claims of the American Company in regard to furnishing non-infringing apparatus and of protecting customers in the use of the same.

The Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., manufacturers of high-class rheostats, have issued a perpetual catalogue describing their electric motor-controlling devices. It is in the form of a cover handsomely bound in green cloth, lettered in gold, and provided with a filing device by which sheets of new descriptive matter and illustrations can be added to the catalogue as desired. The idea is one that should appeal to a customer who desires to keep on file this company's latest bulletins.

The York Telephone Company, of York, Pa., reports that the new multiple switchboard of 1,200 metallic line capacity, furnished and installed by the American Electric Telephone Company, of Chicago, is now in full operation, with the result that the service is greatly improved. Already a large increase in the number of subscribers has resulted directly from the rapid and perfect service afforded their patrons through the new multiple switchboard. The York switchboard is arranged for magneto-call telephones, and has an ultimate capacity for 3,000 lines.

Free Evening Schools of the General Society of Mechanics and Tradesmen.

We take pleasure in calling the attention of our readers in New York and vicinity to the opportunities for evening study afforded by the General Society of Mechanics and Tradesmen. This society, founded by master mechanics and engineers in 1785, has had an honorable and useful career for more than a century. It started its free schools for teaching drawing to young mechanics long before public schools were instituted and has helped many young men to better positions and higher salaries. Within the last year the society has moved into the spacious building formerly occupied by the Berkeley School, in West Forty-fourth street, and have fitted up the greater portion of the building as schoolrooms where instruction is given three nights each week in all branches of mechanical, architectural, freehand and ornamental drawing, and mathematics. The equipment of the school is modern and the instruction practical and thorough. The society's extensive library is accessible to the students as well as a complete set of models which have recently been purchased. The course begins early in October, but to insure registration, application may be made now by calling at the school building, 20 West Forty-fourth street, any Monday, Wednesday or Friday evening between 7.30 and 9.30.

The Lincoln Supreme Court has decided that the Railroad Commission may determine the telephone rates in Nebraska. The Commission, it is said, is expected now to cut the rates in halves.

ELECTRIC RAILWAYS

The Baltimore & Ohio Railroad is to use electric locomotives on a 17-mile grade up the Allegheny Mountains. They will assist the ordinary locomotives in pulling the heavy freight trains up the steep grade.

Gen. Wm. A. Bancroft, president of the Boston Elevated Road, says that it is doubtful if the elevated road will be running inside of 15 months, owing to the delay in securing construction material. He says 50 additional miles of surface track will be laid this year.

At a meeting of the board of directors of the Montreal, P. Q., Street Railway Company it was decided, with the approval of the stockholders, to increase the paid-up capital of the company from $5,000,000 to $6,000,000. It is proposed to issue the new stock to the shareholders at the rate of one share to five. According to its charter, the company has the right to increase its capital stock to $10,000,000. The additional million will be used for bettering the company's service, such as an extension to the power house and building new cars.

The Philadelphia *Inquirer* is authority for the statement that the Philadelphia & Reading Railway Company will adopt electricity for the operation of its trains between New York city and Philadelphia, and that the present running time of express trains of two hours will be reduced to one hour. It is thought that only two power stations will be necessary, although one, located at Trenton, may prove to be sufficient. Alternating current will be used.

Local capitalists of Canal Dover, Ohio, are engineering a plan which they believe will result in a continuous trolley line across Ohio from Lake Erie to the Ohio River, which, it is argued, can be operated to a better advantage when the electric lines which now stretch over a good part of the state are connected and the untracked portions bridged over. There is at present an electric line from Cleveland southward to Akron. Right of way has been secured from Massillon south to Canal Dover. From that place to Uhrichsville, 13 miles southward, a trolley line has been in operation for several years. Between Uhrichsville and Cadiz, still farther south, right of way has already been bought up, and the survey for the line made. From Cadiz to Wheeling, on the river, there is already a line in operation.

ADVANCE INFORMATION

Electric Railways.

NEW YORK CITY—The New York, Brooklyn & New Jersey Rapid Transit Company, of New York city, has been incorporated. It proposes to construct and operate a compressed air or electric road six miles long from Manhattan to Brooklyn. Its capital stock is $60,000, and its directors are Geo. Wilson, Adrian H. Muller, Frank N. Glover, James M. Muller, William A. Armstrong, L. F. W. Wallace, and H. N. Glover, of New York city, and John La Bura, of Jamaica, and A. L. Falk, of Brooklyn. George Wilson subscribes for $58,600 of the company's capital stock.

VERSAILLES, IND.—The Versailles & Osgood Railway Company has been incorporated with a capital stock of $70,000. The directors are Grant Johnson, Alfred H. Beer, Frank S. Jones, W. D. Wilson and Robert A. Creigmile. The company will establish an electric line from Versailles to Osgood.

LOGANSPORT, IND.—The Logansport, Rochester & Northern Traction Company has filed resolutions increasing the capital stock of the company from $100,000 to $1,000,000.

ANNAPOLIS, MD.—A bill has been introduced to incorporate the Baltimore County & City Railway Company. The incorporators are Messrs. Richard P. Choate, John S. Waters, James S. Russell, John A. Miller, Howard M. Towles, Ambrose C. Dunn, Ferdinand Bernheimer and William C. Connors. The capital stock of the company is fixed at $50,000, with the privilege of increasing it to $300,000.

PITTSBURGH, PA.—The Union Traction Company has been chartered with a nominal capital of $1,000. This is the new company organized to acquire control of the traction lines of Pittsburgh, Allegheny City and the suburbs from Wilkinsburg to East Pittsburgh. The officers of the Consolidated Traction Company have promised to issue a circular to stockholders and a special meeting of that company will be held March 31, to vote on a proposition to lease the property and franchises to the new company. The capital of the latter will be increased as occasion may require to a total which may reach $40,000,000. The incorporators are Arthur M. Richmond, Frank H. Clark, Arthur E. Braun, William South and Winfield B. Carson, all of Pittsburgh.

NEWARK, N. J.—Additional articles of incorporation of the Raritan Trolley Company, which is capitalized at $1,000,000, have been filed in the Middlesex County Clerk's office. Papers filed two weeks ago set forth that James C. McCoy was the largest stockholder. In the papers filed later the name of Adolph Lewisohn, of New York, is substituted for that of Mr. McCoy, and the latter is made agent of the company, with an office in Perth Amboy. The company intends to build a trolley line through Raritan and Woodbridge townships, connecting Perth Amboy and Metuchen.

PITTSBURGH, PA.—The contract for the branch lines of the Pittsburgh & Birmingham Traction Company will be let this week. There are seven miles of new road to be built at a cost of about $300,000.

CADIZ, OHIO—Harrison County has granted to J. A. White the franchise for an electric railroad connecting Wheeling and Cadiz.

VALPARAISO, IND.—The Board of County Commissioners have granted a franchise to Grant Mitchener, of this city, for an interurban railway from Valparaiso *via* Chesterton to Michigan City and to the West County line, where it will connect with a line to Chicago. Chicago and eastern capitalists are back of the enterprise, and work on the road will begin early in the Spring. The line will connect with the Northern Indiana Railway at Michigan City.

KAUKAUNA, WIS.—The Fox River Valley Interurban Electric Railway, which was seeking a franchise here, has been obliged to change its name to the Wisconsin Traction, Light, Heat and Power Company. The new franchise was applied for by the president of the company, John I. Beggs, of Milwaukee. The two lines will connect at Appleton and will form a link in the line from Oshkosh to Green Bay.

Electric Light and Power.

BRIDGEPORT, PA.—A charter has been granted at Harrisburg to the Bridgeport Electric Light, Heat and Power Company, capital, $12,500.

PITTSBURGH, PA.—The Southern Light, Heat and Power Company, operating electric plants at Crafton, Carnegie and McKees Rocks, has filed a mortgage for $300,000, to guarantee bonds to be issued to build proposed extensions south of the Monongahela River. The McKees Rocks plant is to be enlarged, to become the central power plant of the system.

MANCHESTER, N. H.—The Manchester Electric Company has notified the Secretary of State of an increase in its capital stock from $600,000 to $1,000,000. This can be done under its charter without further legislative permission, as under the general law the corporation had the right to issue stock to the amount of $1,000,000, but had not before availed itself of the full limit of this privilege.

PATCHOGUE, L. I.—The stockholders of the Patchogue Electric Light Company will hold a special meeting March 21 to vote upon a proposition to increase the capital stock of the corporation from $20,000 to $40,000.

SEA CLIFF, L. I.—The Sea Cliff Village Board has granted to the Franklin Electric Illuminating Company a franchise to furnish heat, power and light throughout the village for a term of 25 years. The old franchise under which the company operated was for a term of five years. It expires March 21, 1900.

Miscellaneous.

BUFFALO, N. Y.—The Buffalo Electro-Surgical Instrument Company has been incorporated with a capital of $9,000. The directors are John C. Becker, E. C. Lapham and Charles Taylor, all of Buffalo.

Telephones.

AMBLER, PA.—The Ambler Telephone Company has been organized by the election of the following officers: President, John S. Buchanan; vice-president, L. S. Moore; secretary, William S. Acuff; treasurer, Joseph A. Angeny; directors: John S. Buchanan, L. S. Moore, Rev. A. H. Rufe, William J. Devine, William S. Acuff, Joseph S. Angeny and Dr. D. W. Shelly. William J. Devine has been made superintendent and will at once commence the erection of the line.

FAYETTEVILLE, N. Y.—Madison & Onondaga Telephone and Telegraph Company has been incorporated to operate in the villages of Onondaga and Madison Counties. Capital, $20,000; directors: Frank E. Dawley and Ellis Woodworth, Fayetteville.

The American Bell Telephone Company.

[*From the Beacon, Boston, Mass.*]

The prestige of this company [the American Bell Telephone Company] is rightly great, and its position, if not impregnable, decidedly strong. But one can not help noting the absence of strong men surrounding the much-respected president of this company. One sees no one taking the place of the late Mr. Storrow, who surely did more than to guide the company legally in the difficult early days of its career. The death of Mr. W. H. Forbes likewise must have left a serious gap in the management. May one not ask whether the present directors have looked far enough ahead and drawn to themselves the young men of most promise, to carry on the company in the days of large things, which are bound to come? Large salaries for incompetent officials are a useless waste. But nothing so clearly marks an intelligent company as its readiness to pay amply for the right men.

Receiver Appointed.

Supreme Court Justice Almet F. Jenks has appointed James A. C. Johnson receiver of the New York Electrical Works, of Nos. 515 and 521 Kent avenue, Brooklyn, N. Y., in a proceeding by the directors for a voluntary dissolution of the corporation. The creditors are enjoined from interfering with the receiver.

ELECTRICAL PATENTS

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED MARCH 6, 1900.

(Concluded.)

644,671 Electric motor car; C. M. Johnson, New York, N. Y.

644,683 System of ignition; W. H. Pumphrey, New York, N. Y.—A reservoir for inflammable fluid, a cup, connections from the reservoir to the cup, an electric igniter in the cup, a valve and means controlling the ignition and the flow of the fluid from the reservoir to the cup.

644,684 Dynamo-electric machine; H. G. Reist, Schenectady, N. Y.

644,714 Telegraph sounder; S. F. Lively, Alderson, W. Va.

644,716 Electric car brake; U. E. Maille, Providence, R. I.

644,745 Electric switch; N. Marshall, Newton, Mass.

644,779 Process of manufacturing metallic carbonates by electrolysis; J. W. Richards, Bethlehem, Pa.

644,783 Electric glow lamp; J. Van Vleck, New York, N. Y.—A glower, means for producing a flame to heat the same and means for extinguishing said flame controlled by the current established in said glower.

644,784, 644,785 Electric glow lamp; J. Van Vleck, New York, N. Y.

644,790 Railway signaling system and apparatus therefor; H. Bezer, New Rochelle, N. Y.—Consists of a pair of opposing magnet coils arranged in series in a normally-closed circuit, and an armature between said coils, and means for actuating said armature by shunting the circuit of one of said coils.

644,794. Tool for laying conduits for electrical conductors; J. F. Cummings, Detroit, Mich.—A tool for laying conduit for electrical conductors comprising a central stem and a non-collapsible alinging and scraper helix surrounding and fixedly secured to said stem of a size to fit the bore of the conduits.

644,816 Electric arc lamp; W. J. Davy, London, Eng.

644,823 Electric lamp for bicycles; G. Heidel, St. Louis, Mo.

644,844 Electric switchboard; M. T. Bunnell, New York, N. Y.—Consists of conducting switch bars, and one or more conducting switch plugs adapted to make electrical contact directly between the bars, springs adapted to exert lateral pressure against the plugs in such manner as to cause them to bear frictionally and laterally against both of the interconnected bars.

644,850 Fuse block; H. P. Davis, Pittsburgh, Pa.—A fuse having a terminal piece at each end and comprising a shell, a metal base, a filling of loosely-packed asbestos or similar material and a follower.

644,852 Electric pump; Carl Eickemeyer, Yonkers, N. Y.

644,859 Electrical measuring instrument; A. H. Hoyt, Penacook, N. H.

644,860 Electric gas-lighter; C. Hubert, New York, N. Y.

644,864 Electromotive force regulation; B. G. Lamme, Pittsburgh, Pa.

644,865 System of electrical distribution; B. G. Lamme, Pittsburgh, Pa.—A two-phase motor, a two-phase primary or secondary generator and means for connecting the motor windings to intermediate leads and to extreme leads from the generator for different quarter-phase electromotive forces.

644,868 Telephone signal-circuit; D. McNeil, Chadron, Neb.

644,878 Automatic circuit-breaker; D. W. Stinson, St. Louis, Mo.—A lighting or power circuit arranged with a generator for supplying said circuit with alternating currents, a switch and means whereby said switch is actuated when the current or electromotive force in said circuit is at the zero-point of any one alternation.

644,917 Electrical measuring instrument; A. H. Hoyt, Penacook, N. H.

644,962 Electric arc lamp; E. M. Barnes, Cleveland, Ohio.

644,972 Induction-coil for X-ray apparatus; R. A. Fessenden, Allegheny, Pa.

644,995 Vacuum-tube lighting; D. M. Moore, Newark, N. J.

645,007 Protective system and apparatus for high-tension electric currents; L. C. Reed, New Orleans, La.—A circuit-breaker, a ground-circuit from one leg of said system, and a solenoid-transformer for throwing said circuit-breaker into operation, the primary of which is in said ground circuit.

645,008 Protective system of electric distribution; L. C. Reed, New Orleans, La.

645,009 System of electrical distribution; L. C. Reed, New Orleans, La.

645,010 Electric circuit-breaker; L. C. Reed, New Orleans, La.

645,011 Underground system of electrical distribution; W. B. Reed, New Orleans, La.

645,012-13 Electrical distribution system; W. B. Reed.

645,014 System of electrical distribution; W. B. Reed.

645,015 Electric railway; W. B. Reed.

645,021 Underground electric railway; G. W. Smith, Dallas, Tex.

645,041 Vacuum-tube lighting; D. M. Moore, Newark, N. J.

PATENTS.

Twenty years continuous practice with the Western Union Telegraph Company, American Bell Telephone Company, General Electric Company, Electrical Accumulator Company, Postal Telegraph-Cable Company, and other electrical companies.

Correspondence and interviews solicited.

W. B. VAN SIZE, 253 Broadway, N. Y.
Solicitor and Expert.

Electrical House Goods Specialties

ANNUNCIATORS, BATTERIES, CUTOUTS, PUSHES, ETC.

The Electric Gas Lighting Co.

195 Devonshire St., Boston, Mass.

Prism.... Globes AND Shades..

GUARANTEED TO GIVE "MAXIMUM LIGHT, COMPLETE DIFFUSION, MINIMUM GLARE," for directing and diffusing ALL KINDS OF LIGHT.....

MANUFACTURED BY THE

HOLOPHANE GLASS CO.,

1 BROADWAY, NEW YORK, N. Y.

Send for Catalogue and Pamphlets.

The New System OF EDUCATION Steam Engineering

Mechanical, Electrical, Civil and Mining Engineering; Architecture; Drawing; Surveying; Chemistry; Shorthand, Book-keeping and English Branches

TAUGHT BY MAIL.

Students qualified to pass examinations.

We have helped thousands to better positions and salaries. Send for free circulars, stating the subject in which you are interested.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Box 1008, Scranton, Pa.

The Best Education is that which **Increases Your Salary.**

We have helped hundreds of ambitious men to better positions and better salaries. LET US HELP YOU.

Improve your spare time by taking a thorough course in

Steam, Electrical or Mechanical Engineering, BY MAIL.

You can fit yourself for a better position without giving up your old one.

Low tuition, payable in small monthly payments if desired.

Write for **Handbook "B,"** giving prospectus and full particulars.

American School of Correspondence (Chartered by the Commonwealth of Massachusetts). **Boston, Mass., U. S. A.**

"MEN ARE FOUR."

"He who knows not, and knows not he knows not—he is a fool; shun him. He who knows not, and knows he knows not—he is simple; teach him. He who knows, and knows not he knows—he is asleep; wake him. He who knows, and knows he knows—he is wise; follow him."—Arab Proverb.

We know, and we know we know how to build Feed-Water Heaters

Our improved Berryman is a "Little Giant," vastly superior to any other Feed-Water Heater both as to results and durability; 18 years as sellers and manufacturers is the price we paid for our experience.

Try us and you will know, not what you now not know, but what you will then know.

BENJ. F. KELLEY & SON,

91 Liberty St., New York.

We have the largest stock of second-hand Feed-Water Heaters in America, taken in exchange for our improved Berryman.

IT'S NOT AS WIDE AS

A CAMBRIC NEEDLE

yet such a little ribbon of lightning can impair your entire service, unless you are properly protected.

GARTON LIGHTNING ARRESTERS

are prominent among the leaders. They have the smallest air-gap, and do not ground your circuit.

Every little storm does not "Knock them out," and their cost is but little compared with the cost of repairs and inconvenience.

GARTON-DANIELS COMPANY,

Keokuk, Iowa, - U. S. A.

PLATINUM

IN SHEET OR WIRE, ANY SIZE, SHAPE OR DEGREE OF HARDNESS FOR ALL PURPOSES.

BAKER & CO.,

408-410-412-414 N. J. Railroad Ave., Newark, N. J.

New York Office, 120 Liberty Street.

Scrap and Native Platinum Purchased.

GET OUR NEW CATALOGUE.

BOSTON AGENTS: F. A. HOUDLETTE & SON, 138 Milk Street.

CREOSOTED WOOD CONDUITS

WILL LAST FOREVER. EASILY ACCESSIBLE. **FOR UNDERGROUND WIRES.** DO NOT GATHER MOISTURE. DO NOT SCRATCH CABLES.

THE MICHIGAN PIPE CO.,

298 N. Madison St., BAY CITY, MICH.

A National Rider never changes his mount.—National Cycle Mfg. Co., Bay City, Mich.

FOR SALE.

An electric light plant for sale, with a franchise for 20 years in a good town of 3,000 population. For particulars, address

LEWIS MEAD, Mayor,
Council Grove, Kansas.

FOR SALE.

Electric Light Plant and Grist Mill, both run by water and steam. Electric plant for lighting three villages. One Summer hotel paying $1,200 per year for lights.
Reason for selling is to dissolve partnership.

COLVIN & HOUGHTON,
Manchester Centre, Vt.

WANTED.

A second-hand direct-current **DYNAMO** for 110 volts of sufficient size to carry 250 16-candle-power lamps. Address

LOCK BOX 351,
CAMDEN, N. J.

Wanted

for a large electrical engineering works in England, a designer for large continuous-current railway generators and rotaries. Must have been engaged on this work recently and be fully acquainted with latest practice.
A good opening for a capable engineer or designer who has previously acted in a junior position.

ADDRESS "S. D.,"

at the office of ELECTRICAL REVIEW, New York, detailing recent experience and actual work done.

WANTED

First-class Armature Winders for handwork and machine-formed coils to send for our application blank and register with us. Inexperienced persons need not apply.

BULLOCK ELECTRIC MANUFACTURING CO.
Cincinnati, - - - Ohio

WANTED

A fifty (50) horse-power second-hand engine in good repair, a Westinghouse compound preferred. Advise at once your best cash price.

The Rogers & Hubbard Co.,
Middletown, Conn.

CLOCK CONTACTS

and circuit closers fitted to our famous 60-day clock are perfection for alarms, synchronizers, time switches, program devices and electric clocks.
Send for catalogue No 170.

THE PRENTISS CLOCK IMPROVEMENT CO.,
Dept. 17, 49 DEY STREET, N. Y.

THEATRE DIMMERS.

WARD LEONARD ELECTRIC CO.,
Bronxville, N.Y., U.S.A.

Painted Oak Pins & Brackets.

CAR-LOT ORDERS SOLICITED.
PROMPT SHIPMENTS.

KANSAS CITY & SOUTHERN LUMBER COMPANY,
SPRINGFIELD, MO.

POLES ✣ CROSS-ARMS BRACKETS, PINS ✣ TIES

PROMPT SHIPMENT DIRECT FROM MILLS
SAVE BROKERAGES AND SEND US YOUR INQUIRIES

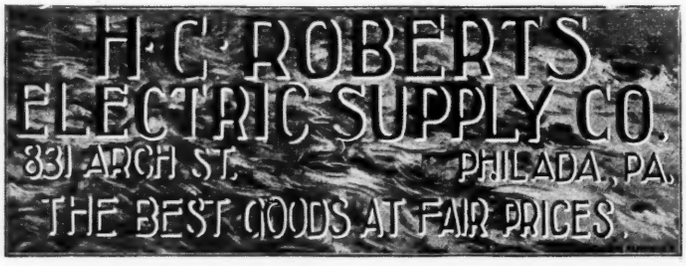
ECCLESTON LUMBER CO.

29 BROADWAY, NEW YORK

SUCCESSFUL ELECTRICIANS

are men of education. Success in the electrical profession is impossible without technical knowledge. You can obtain a thorough electrical education at home during your spare time at a cost so low that you will not notice the outlay. Complete courses by mail in **ELECTRICAL ENGINEERING, Electrical Station Engineering, Electric Railways, Electric Lighting, Telephony, Telegraphy, Electro-Plating, Mechanical Drawing and Dynamo-Electric Machine Design. Best Text-Books Free.** The best, most thorough and practical courses of any correspondence school in the world. Seven years of experience in teaching by correspondence. Write for illustrated circular B, sample pages of text-books, drawing plate and booklet of letters from students all over the world.

THE UNITED CORRESPONDENCE SCHOOLS, 154, 156, 158 FIFTH AVENUE, NEW YORK.
with which are incorporated The Correspondence School of Technology and the Institute for Home Study of Engineering.



SMALL SPRINGS OF EVERY DESCRIPTION
MADE BY
THE WALLACE BARNES CO.
BRISTOL, CONN., U.S.A.
ESTABLISHED 1857.

FLAT OR ROUND WIRE, STEEL OR BRASS.
COLD ROLLED STEEL
KEPT IN STOCK, .003 TO .049 IN THICKNESS.
SPRINGS ENAMELED OR PLATED.
SEND SAMPLES AND WRITE FOR QUOTATIONS.

HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, etc

Non-Magnetic Hair Springs of Phosphor-Bronze and other non-magnetic metals.

Hair Springs of any description manufactured to order.

F. N. MANROSS, Forestville, Conn.

$5 VOLT AMMETER FOR STUDENTS' USE.
(Jewell Bearing and Aluminum Case.)
Adapted to primary and storage battery work.
List of schools using it mailed on application. The method of its use described in a circular just issued.

L. E. KNOTT APPARATUS CO.,
16 Ashburton Place, - BOSTON, MASS.

LIST OF PRACTICAL 10 CENT BOOKS.

No. 1. How to make a Dynamo.
No. 2. How to make a Telephone.
No. 3. How to make an Electric Motor.
No. 4. How to make a Storage Battery.
No. 5. How to make a Wimshurst Electric Machine.
No. 6. How to make a Magneto Machine.
No. 7. How to make a Medical Induction Coil.
No. 8. How to make a Pocket Accumulator.
No. 9. How to make a Plunge Battery.
No. 10. How to make a Voltmeter.
No. 11. How to make a Galvanometer.
No. 12. How to make a Hand Dynamo.

These books are illustrated and the price is only 10 cents each, postpaid.

BUBIER PUBLISHING CO.,
Box 709 LYNN, MASS.

Central Manufacturing Co.

Chattanooga, Tenn.
Manufacturers and Dealers in Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets. **Large stocks on hand.** Delivered prices quoted, F. O. B. cars, your city, in any quantity.

WRITE US.

THE BRADY MAST-ARMS.

T. H. BRADY, New Britain, Conn., U. S. A.

Manufacturer of Mast-Arms, Pole and Swinging Hoods, House Brackets and other Specialties for Construction Work.—*Catalogues and Prices furnished on application.*

INDIA AND AMBER. **MICA** IN ANY SHAPE OR PATTERN.

EUGENE MUNSELL & CO.,
218 Water Street, New York.
117 Lake Street, Chicago.
WRITE FOR SAMPLES AND PRICES.

McINTIRE'S PATENT
Connectors and Terminals.

Special Connectors for HARD-DRAWN COPPER WIRE, all sizes. FUSED WIRE, FUSED LINKS and STRIPS.

THE C. McINTIRE CO.
13 & 15 FRANKLIN STREET, NEWARK, N. J.

J. G. White & Company,

INCORPORATED.
ENGINEERS, CONTRACTORS
29 Broadway, New York, N. Y.
EQUITABLE BLDG., BALTIMORE.

SHEAFF & JAASTAD,

MECHANICAL and ELECTRICAL ENGINEERS.

Plans and specifications for and superintendence of Electric Power and Lighting Plants a specialty.

85 WATER STREET, BOSTON, MASS.

PATENTS TRADE-MARKS COPYRIGHTS

EDWARD S. DUVALL,

Solicitor of Patents,

Counsellor in Patent Causes.

Some time connected with the late Benjamin Butterworth, before he retired from practice to assume the office of Commissioner of Patents.

Prompt attention given to all matters before the Patent Office, and applications for patents prepared here at Washington from sketches, photos, or models, in a manner to give highest satisfaction and with **less expense** than you will incur elsewhere. Write and convince yourself of this fact. As an attorney at Washington is indispensable you can save the expense of having two by communicating directly with me.

LOAN AND TRUST BUILDING,
WASHINGTON, D. C.